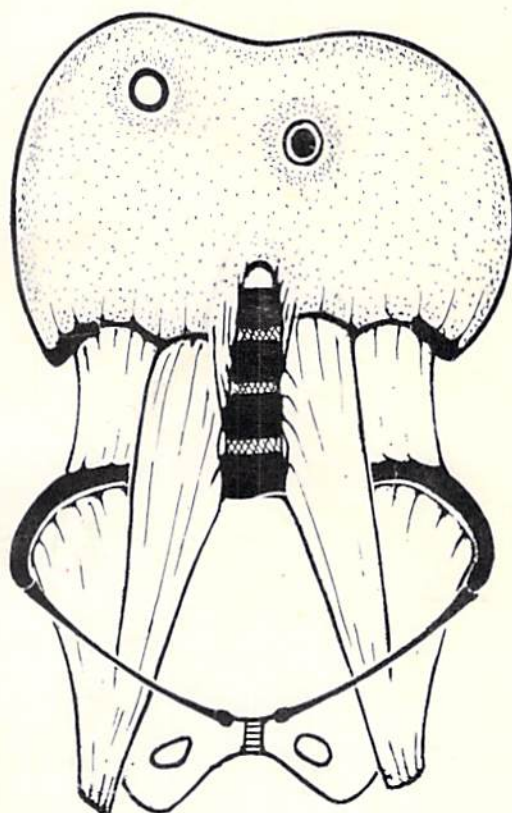
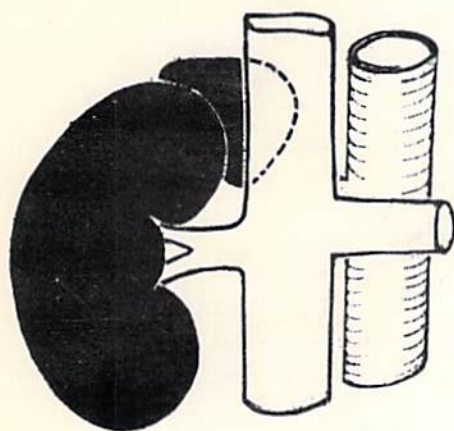


ATLAS OF ANATOMY

ABDOMEN AND PELVIS



by
FAWZI GABALLAH
ZAIZAFON BADAWY

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PREFACE

This "ATLAS OF ANATOMY" contains 510 figures on the anatomy of abdomen and pelvis arranged regionally. Almost all the anatomical facts are illustrated in a clear way, and the diagrams are provided with concise explanatory notes.

The authors hope that this diagrammatic atlas will be helpful to the medical student as a guide to better understanding of anatomy.

Cairo, 1988

**FAWZI GABALLAH
ZAIZAFON BADAWY**

OTHER BOOKS BY PROF. FAWZI GABALLAH

1. Atlas of Embryology.
2. Basic Embryology.
3. A Summary of Anatomy (all parts).
4. Basic Neuroanatomy.
5. Oral Questions in Anatomy.

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ABDOMEN PROPER

ANTEROLATERAL ABDOMINAL WALL

INTRODUCTION

Fig.(1): BOUNDARIES OF THE ABDOMINAL CAVITY (L.S.)

The abdominal cavity is subdivided into the abdomen proper (a) and the pelvis (b).

1. upper boundary: formed by the diaphragm.
2. anterior boundary: formed by the anterior abdominal wall.
3. umbilicus.
4. line of junction between the abdomen proper and pelvis (inlet of the pelvis).
5. scrotum.
6. floor of the pelvis.
7. posterior boundary: formed by the posterior abdominal wall.
8. back of the body.

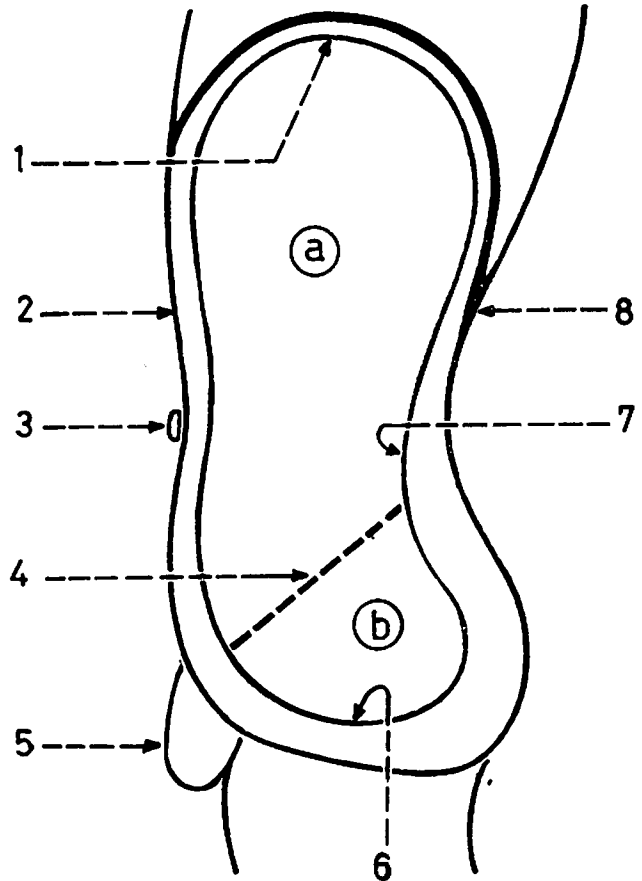


Fig.(2): BOUNDARIES OF THE ABDOMEN PROPER (T.S.)

- (a) Anterior boundary: is formed mainly by the rectus abdominis muscle (1) and the aponeuroses of the 3 flat muscles (2).
- (b) Lateral boundary: is formed mainly by the fleshy parts of the 3 flat muscles: external oblique, internal oblique and transversus abdominis (3).
- (c) Posterior boundary: is formed by the posterior abdominal wall.
- (d) Back of the trunk (is the part behind the vertebral column).

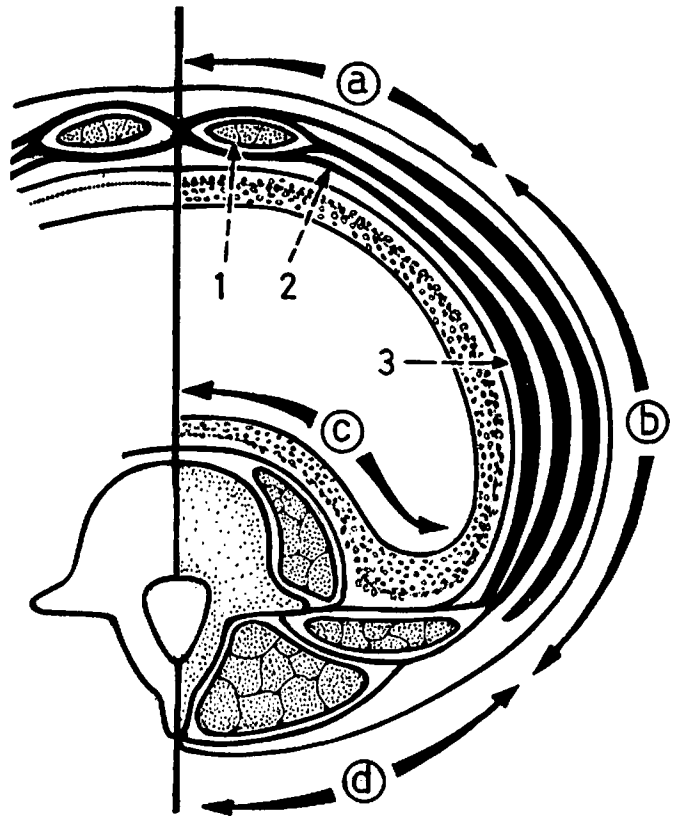


Fig.(3): LAYERS OF THE ANTERO-LATERAL ABDOMINAL WALL (T.S.)

The anterolateral wall forms the anterior and lateral boundaries of the abdomen proper. Its layers are: skin, superficial fascia, muscles, fascia transversalis, extraperitoneal tissue and parietal peritoneum (from without inwards).

1. muscle layer.
2. membranous layer of superficial fascia.
3. fatty layer of superficial fascia.
4. skin.
5. parietal peritoneum.
6. extraperitoneal tissue.
7. fascia transversalis.

- (a) anterolateral abdominal wall.
 (b) posterior abdominal wall.
 (c) back of the trunk.

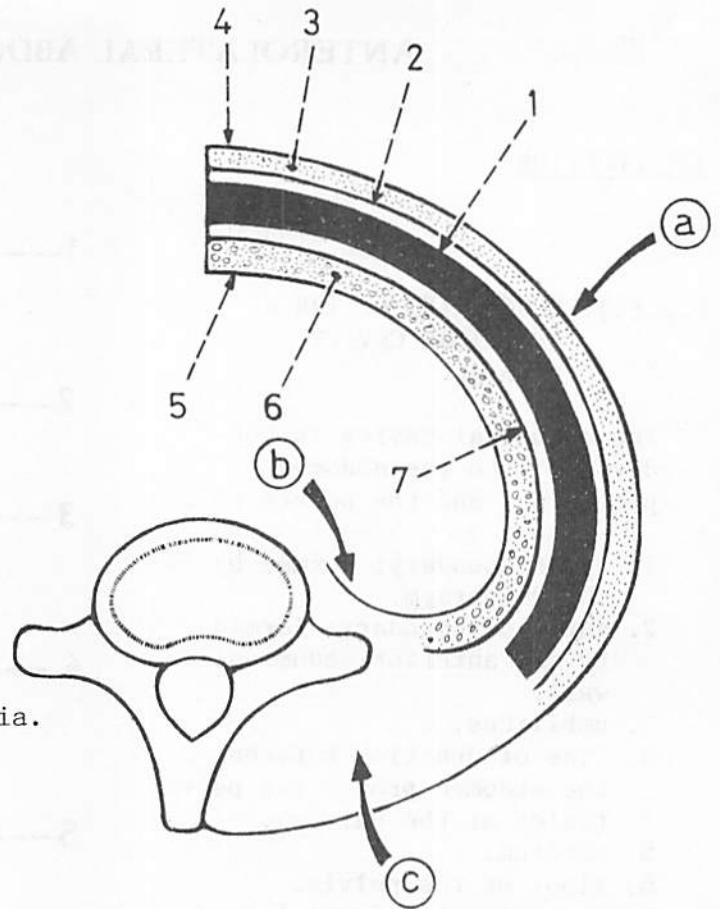
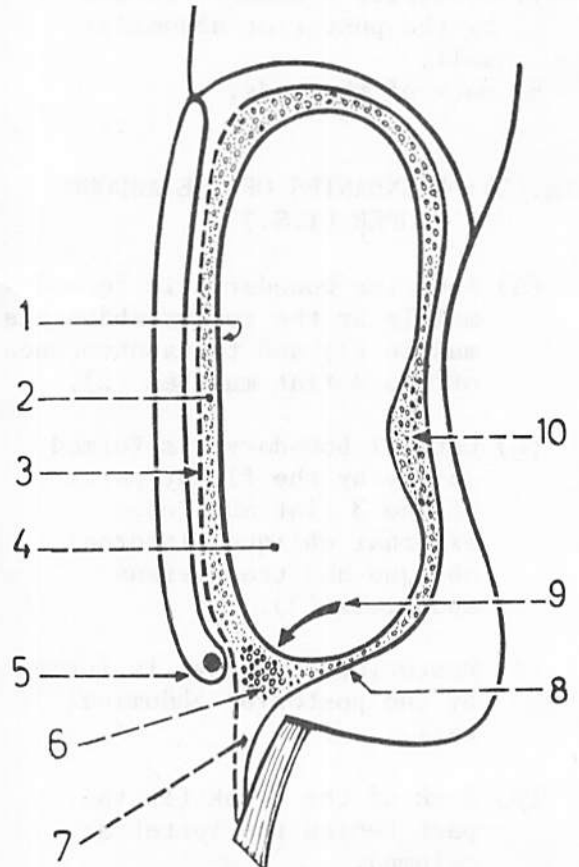


Fig.(4): EXTRAPERITONEAL TISSUE

It is a layer of fatty areolar tissue situated immediately to the outside of the parietal peritoneum.

1. parietal peritoneum.
2. extraperitoneal tissue.
3. fascia transversalis.
4. abdominal cavity.
5. inguinal ligament.
6. femoral septum (condensed extraperitoneal tissue filling the femoral ring).
7. femoral canal.
8. fascia iliaca.
9. site of femoral ring.
10. condensed extraperitoneal tissue around the kidney.



SUPERFICIAL FASCIA

Fig.(5): LAYERS OF SUPERFICIAL FASCIA

The superficial fascia consists of a superficial fatty layer (Camper's fascia) and a deep membranous layer (Scarpa's fascia).

1. superficial fatty layer.
2. deep membranous layer.
3. Colles' fascia: the continuation of the membranous layer of superficial fascia into the perineum.
4. penile urethra.
5. dartos muscle: it is the muscle of the scrotum; it replaces the fatty layer of superficial fascia.
6. Colles' fascia in the scrotum.
7. symphysis pubis.
8. muscle layer of anterior abdominal wall.

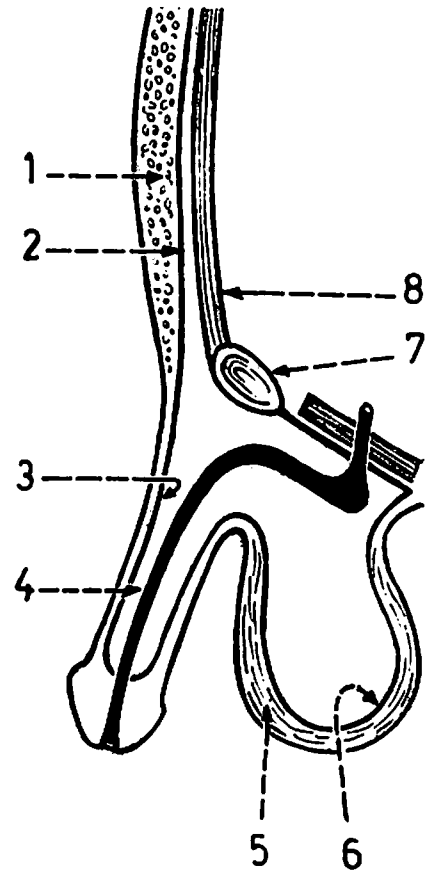


Fig.(6): FUNDIFORM LIGAMENT OF THE PENIS

The membranous layer of superficial fascia is adherent to the linea alba and is prolonged over the dorsum of the penis to form the fundiform ligament.

1. linea alba.
2. fundiform ligament of the penis.
3. dorsum of the penis.

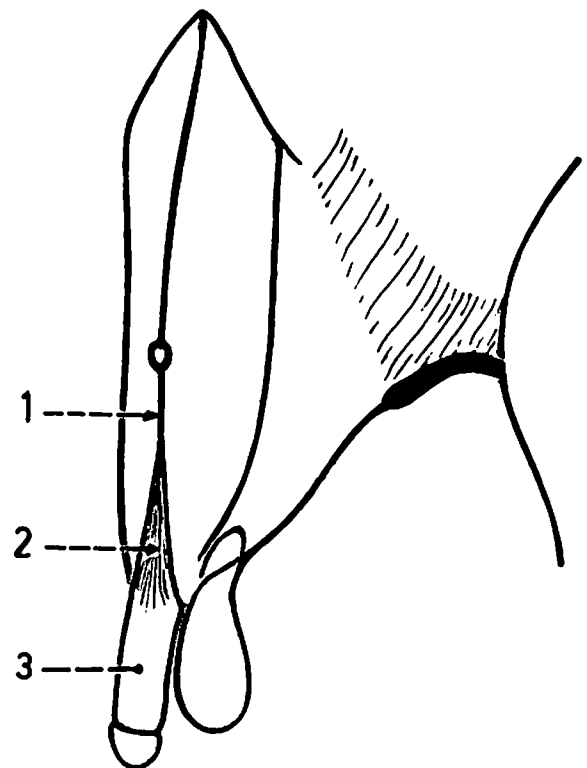
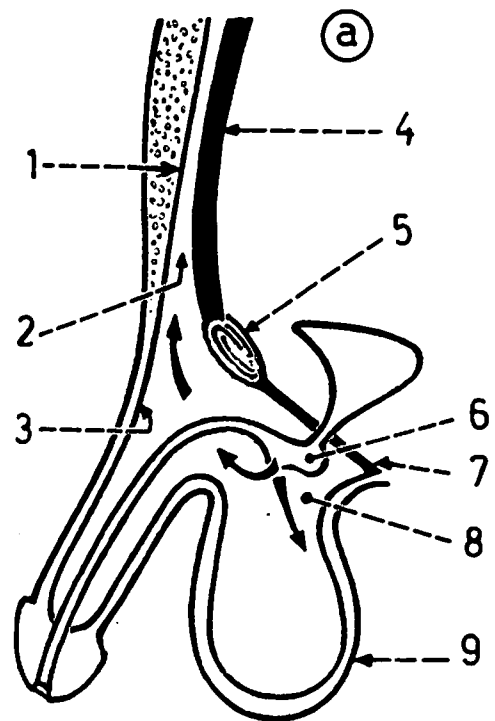


Fig.(7): RUPTURE OF SPONGY (PENILE) URETHRA

Rupture of the spongy urethra (by trauma) leads to extravasation of urine in the superficial perineal pouch. This urine then spreads upwards into the anterior abdominal wall but is prevented from passing into the thigh due to the attachment of Colles' fascia to the sides of the pubic arch. The urine collected in the anterior abdominal wall cannot descend into the thigh due to the attachment of Scarpa's fascia to the fascia lata of the thigh a little below the inguinal ligament.

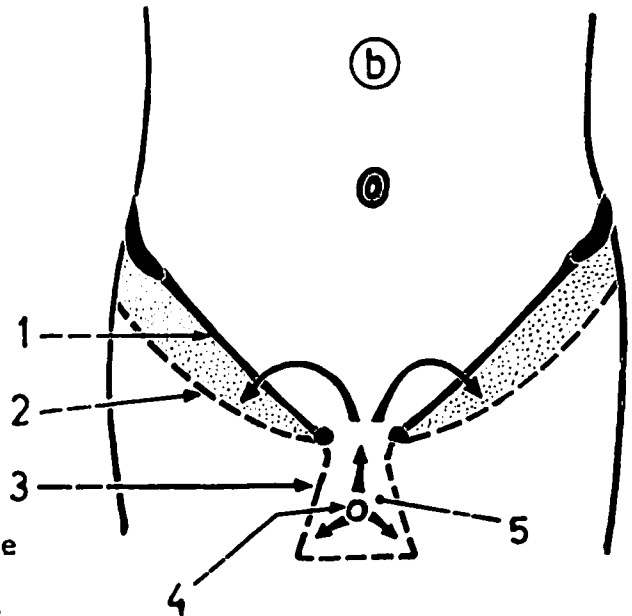
(a) Side view:

1. membranous layer of superficial fascia.
2. space deep to membranous layer of superficial fascia into which urine ascends.
3. Colles' fascia.
4. muscle layer of anterior abdominal wall.
5. symphysis pubis.
6. ruptured urethra.
7. perineal membrane.
8. superficial perineal pouch into which extravasated urine collects.
9. scrotum.



(b) Anterior view:

1. inguinal ligament.
2. line of attachment of Scarpa's fascia to the fascia lata of the thigh.
3. attachment of Colles' fascia to the side of pubic arch.
4. ruptured urethra.
5. superficial perineal pouch.



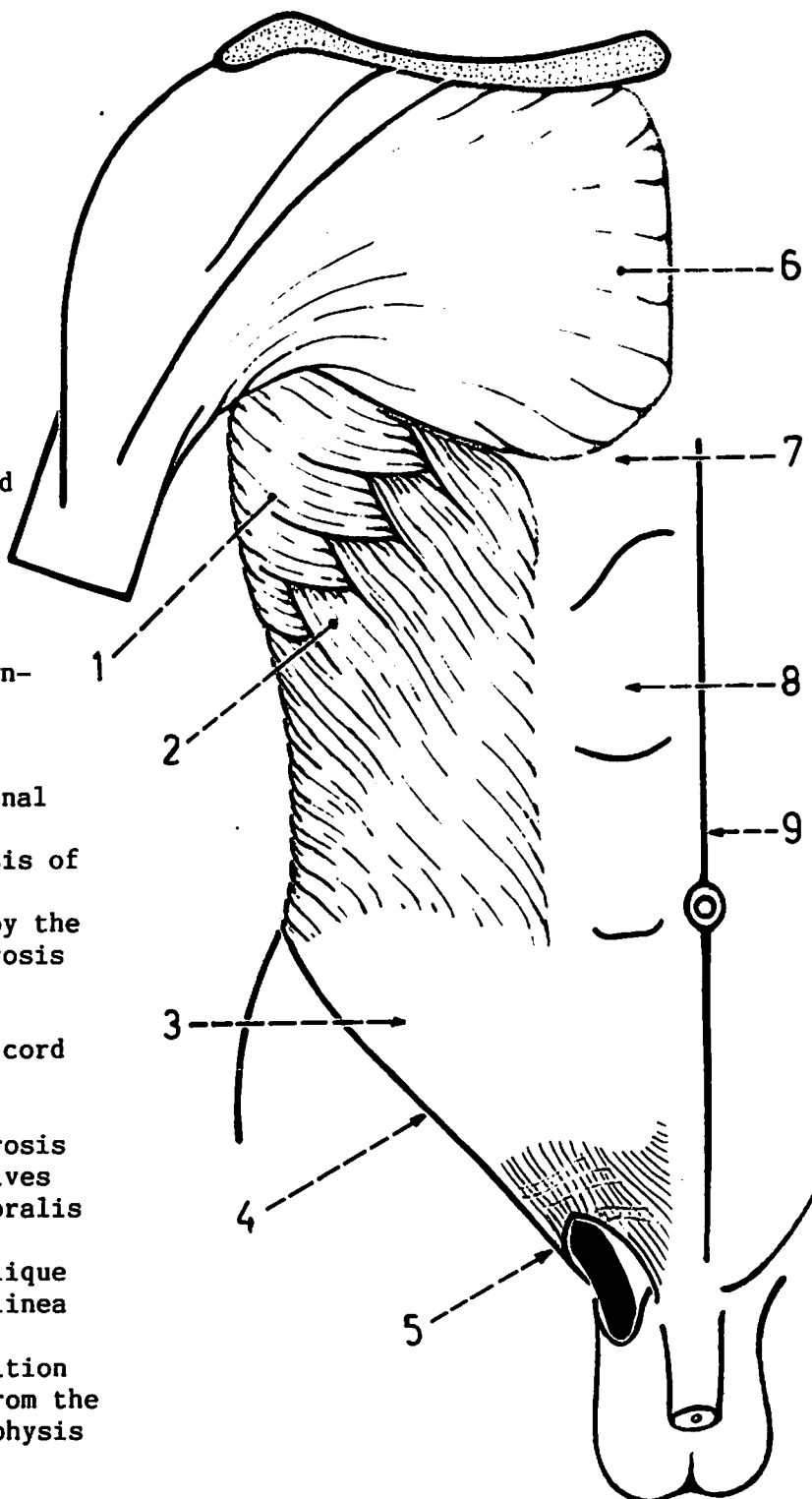
MUSCLES OF ANTEROLATERAL ABDOMINAL WALL

- * External oblique.
- * Internal oblique.
- * transversus abdominis.
- * Rectus abdominis.
- * Pyramidalis.

Fig.(8): EXTERNAL OBLIQUE MUSCLE

It is the most superficial of the 3 flat anterolateral muscles of the abdominal wall. It has a fleshy part which arises by digitations and has an aponeurosis which forms the inguinal ligament and is perforated at its lower and medial part to form the superficial inguinal ring. Its fleshy fibres are directed downwards and medially.

1. serratus anterior.
2. fleshy digitations of external oblique.
3. lower part of the aponeurosis of external oblique.
4. inguinal ligament (formed by the lower border of the aponeurosis of the external oblique).
5. superficial inguinal ring transmitting the spermatic cord in the male.
6. pectoralis major.
7. upper border of the aponeurosis of the external oblique (gives partial origin to the pectoralis major).
8. aponeurosis of external oblique extending medially to the linea alba.
9. linea alba (a fibrous partition extending in the midline from the xiphoid process to the symphysis pubis).



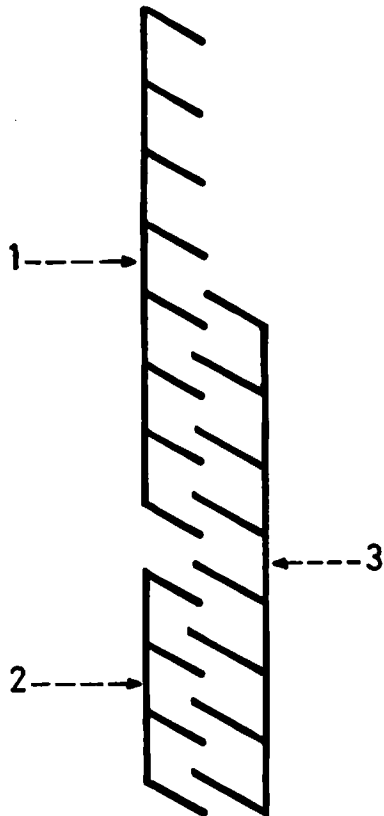


Fig.(9): DIGITATIONS OF ORIGIN OF EXTERNAL OBLIQUE MUSCLE

The muscle arises by 8 fleshy digitations from the lower 8 ribs. This origin interdigitates with the serratus anterior (above) and the latissimus dorsi (below).

1. digitations of serratus anterior: from upper 8 ribs.
2. digitations of latissimus dorsi: from lower 4 ribs.
3. digitations of external oblique: from lower 8 ribs.

Fig.(10): FLESHY AND APONEUROTIC PARTS OF EXTERNAL OBLIQUE MUSCLE

The fleshy fibres end in an aponeurosis opposite a vertical line descending from the 9th costal cartilage. No fleshy fibres extend below a line drawn from the anterior superior iliac spine to the umbilicus.

1. upper and middle fibres: run downwards, forwards and medially.
2. posterior fibres: run vertically downwards.
3. anterior superior iliac spine.
4. inguinal ligament.
5. umbilicus.
6. aponeurosis.
7. line of junction between the fleshy part and the aponeurosis.

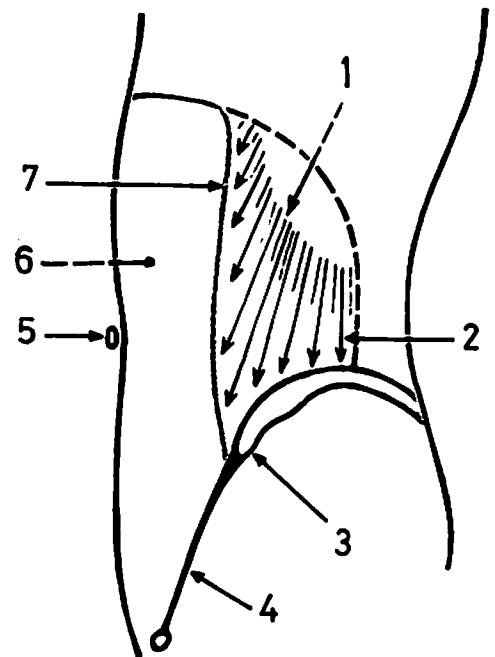
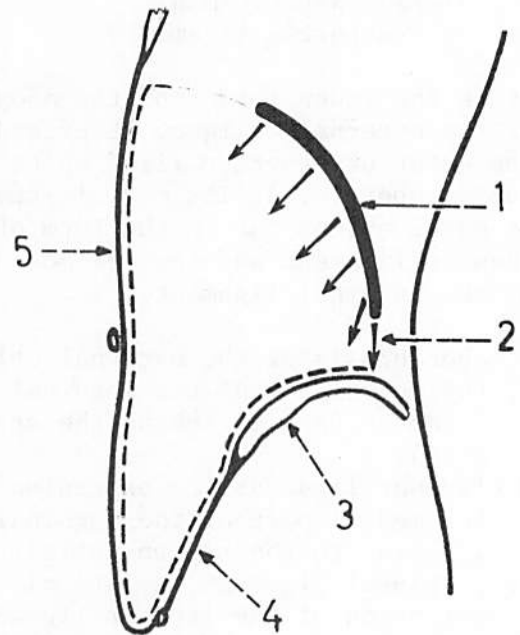


Fig.(11): ORIGIN AND INSERTION OF THE EXTERNAL OBLIQUE MUSCLE

The muscle arises by 8 fleshy digitations from the lower 8 ribs and is inserted mainly into the anterior $\frac{1}{2}$ of outer lip of iliac crest (fleshy) and into the linea alba (aponeurotic).

1. origin of the muscle.
2. most posterior fibres (descend vertically and form the free posterior border of the muscle).
3. iliac crest (insertion).
4. inguinal ligament (formed by the lower border of the aponeurosis).
5. linea alba.



* The free posterior border of the muscle forms the anterior boundary of the lumbar triangle.

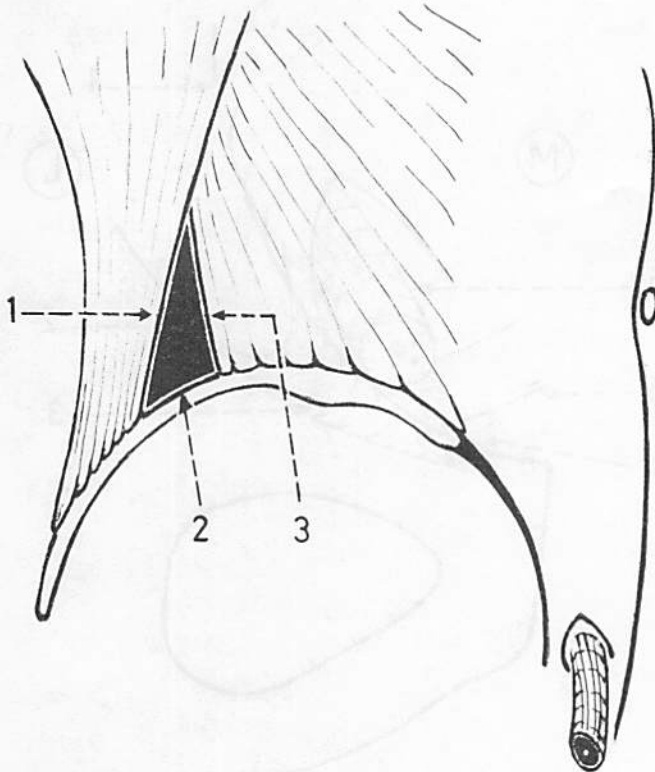


Fig.(12): LUMBAR TRIANGLE

It is a small triangle situated in the lower part of the back immediately above the middle part of the iliac crest. It is a rare site for hernia (lumbar hernia).

1. posterior boundary of the triangle: by the free lateral border of latissimus dorsi.
2. base of the triangle: by middle part of the iliac crest.
3. anterior boundary of the triangle: by the free posterior border of the external oblique.

* Note that the floor of the triangle is formed by the internal oblique and transversus abdominis muscle.

Fig.(13): INGUINAL LIGAMENT
(Poupart's ligament)

It is the lower border of the aponeurosis of the external oblique. It extends from the anterior superior iliac spine to the pubic tubercle. At its medial attachment it has 2 extensions in the form of the lacunar ligament and the reflected part of the inguinal ligament.

1. aponeurosis of the external oblique.
2. reflected part of the inguinal ligament (passes behind the spermatic cord).
3. lacunar ligament (an extension from the medial part of the inguinal ligament to the pecten pubis).
4. pectineal ligament (a lateral extension of the lacunar ligament over the superior ramus of the pubis).
5. free lateral border of the lacunar ligament (forms the medial boundary of the femoral canal).
6. inguinal ligament (convex downwards and concave upwards).

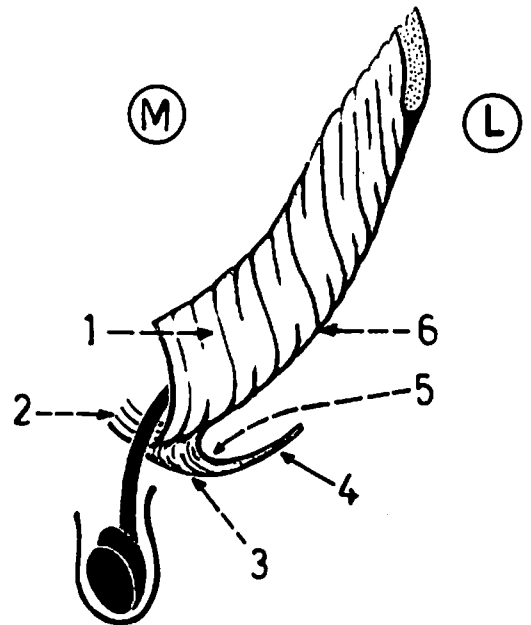


Fig.(14): PARTS OF INGUINAL LIGAMENT

These are the lacunar ligament and the reflected part of inguinal ligament.

1. medial part of inguinal ligament.
2. pectineal ligament (a lateral extension of the lacunar ligament along the superior ramus of the pubis).
3. lacunar ligament (triangular in shape with its base forming a free curved border and its apex at the pubic tubercle).
4. pubic tubercle.
5. reflected part of inguinal ligament (extends upwards and medially behind the spermatic cord).
6. spermatic cord emerging through the superficial inguinal ring.

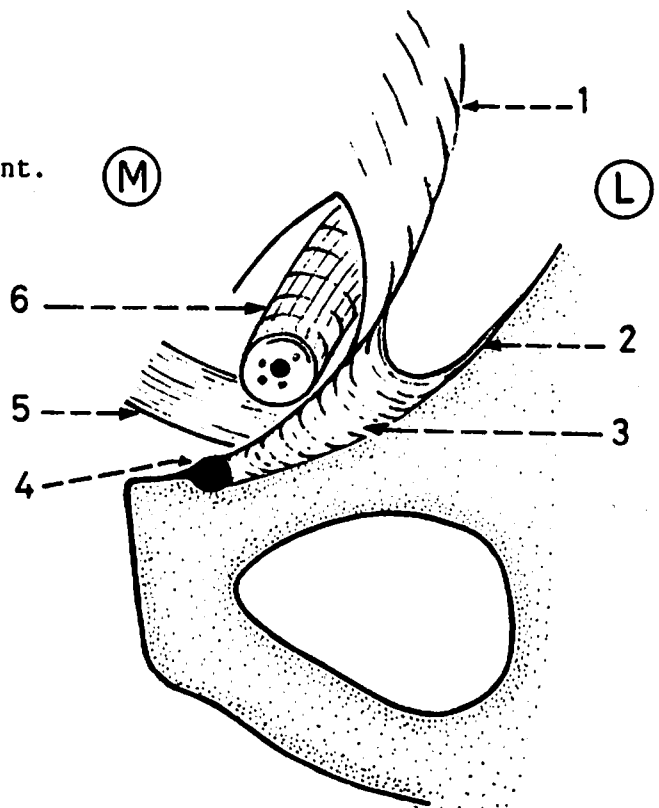


Fig.(15): SUPERFICIAL AND DEEP RELATIONS OF THE INGUINAL LIGAMENT

The ligament is related superficially to 3 vessels: superficial circumflex iliac, superficial epigastric and superficial external pudendal. It is related deeply to 2 vessels: inferior epigastric and deep circumflex iliac.

1. deep circumflex iliac artery.
2. superficial epigastric artery.
3. inferior epigastric artery.
4. spermatic cord emerging through the superficial inguinal ring.
5. superficial external pudendal artery.
6. inguinal ligament.
7. superficial circumflex iliac artery.

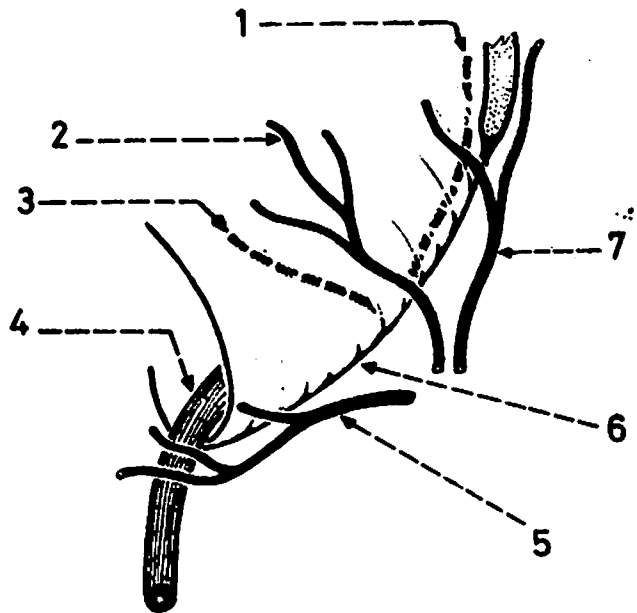
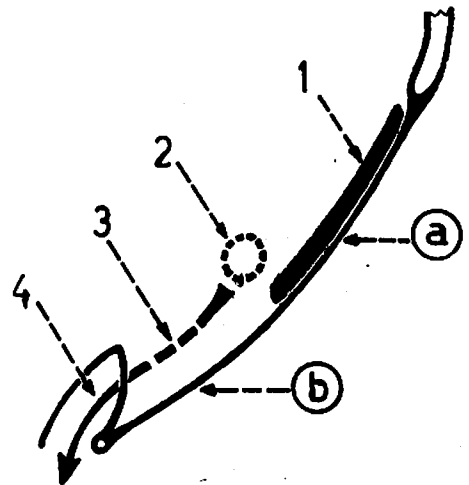


Fig.(16): SUPERIOR RELATIONS OF THE INGUINAL LIGAMENT

The medial part of the grooved upper surface of the inguinal ligament forms the floor of the inguinal canal and is related to the spermatic cord in the male or the round ligament of the uterus in the female. Its lateral part gives origin to the internal oblique and transversus abdominis muscles.

- (a) Lateral part of inguinal ligament.
(b) Medial part of inguinal ligament.

1. origin of internal oblique and transversus abdominis.
2. deep inguinal ring.
3. arrow in the inguinal canal.
4. superficial inguinal ring.



* The inguinal canal begins at the deep ring and ends at the superficial ring.

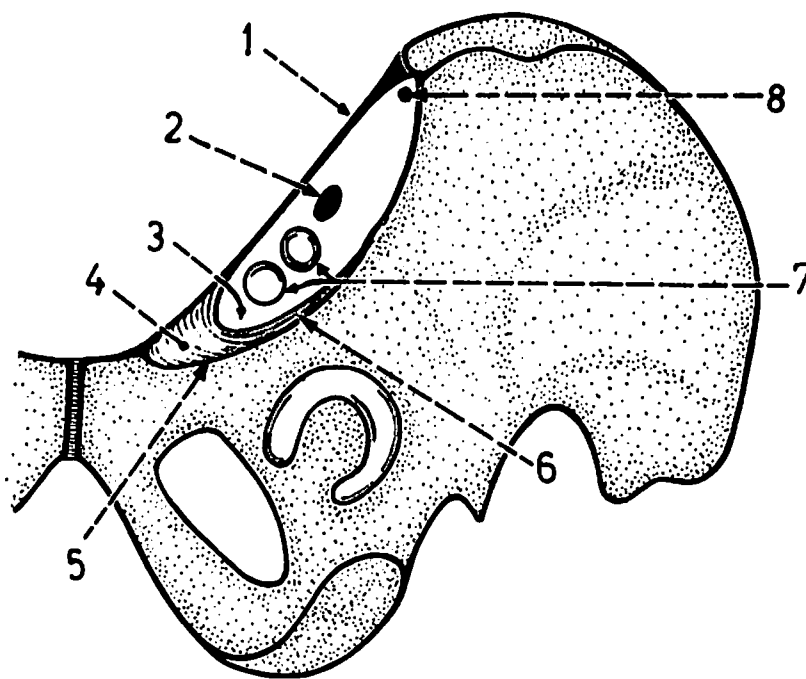


Fig.(17): INFERIOR RELATIONS OF THE INGUINAL LIGAMENT

These are the structures situated between the inguinal ligament and the hip bone and include the following: femoral sheath and its contents (femoral artery, femoral vein and femoral canal), femoral nerve, ilio-psoas muscle and lateral cutaneous nerve of the thigh.

1. inguinal ligament.
2. femoral nerve.
3. femoral canal.
4. lacunar ligament.
5. pecten pubis (pectineal line).
6. pectineal ligament (Cooper's ligament).
7. femoral vessels.
8. lateral cutaneous nerve of the thigh.

* Note that the medial part of the inguinal ligament intervenes between the inguinal canal above and the femoral canal below. The inguinal canal is the route for the inguinal hernia, while the femoral canal is the route for the femoral hernia.

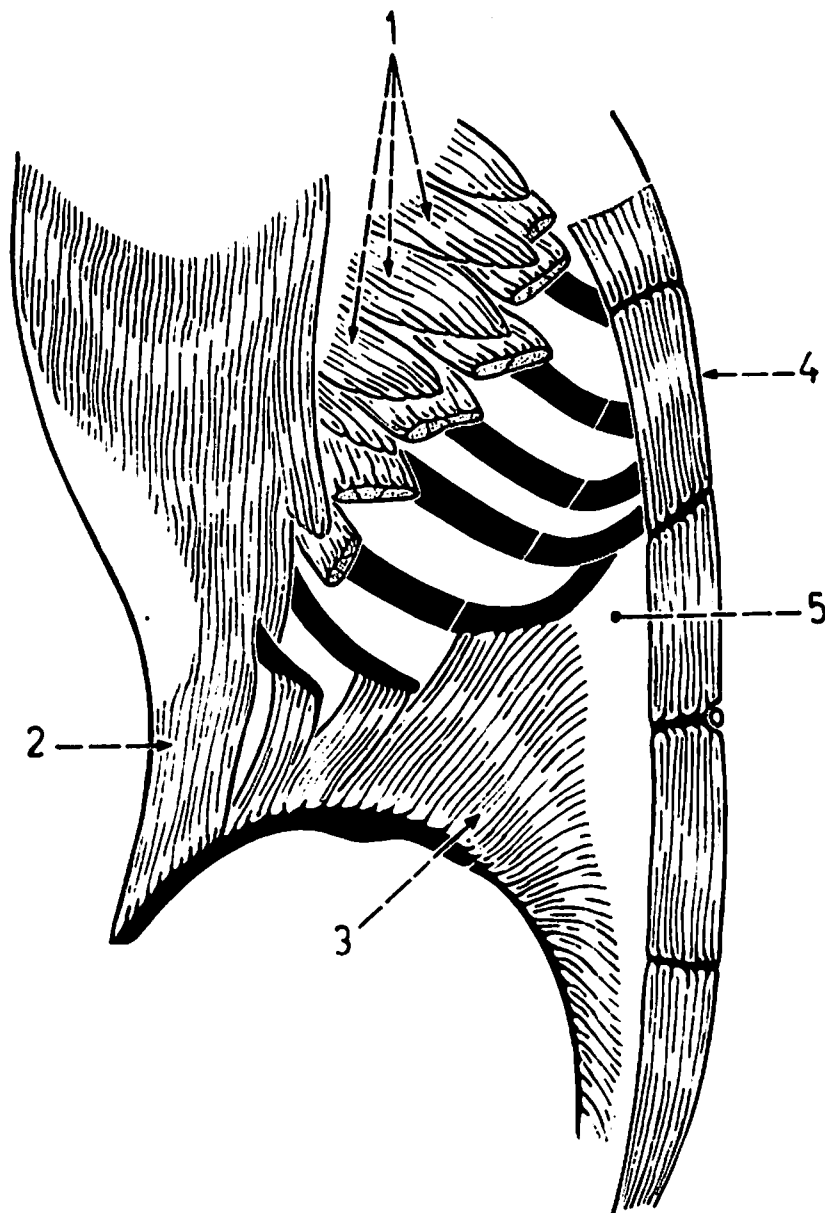


Fig.(18): INTERNAL OBLIQUE MUSCLE

This muscle lies under cover of the external oblique and its fleshy fibres pass upwards, forwards and medially to end in an aponeurosis.

1. digitations of serratus anterior interdigitating with those of the external oblique muscle.
2. latissimus dorsi.
3. fleshy fibres of the internal oblique muscle.
4. rectus abdominis muscle (a vertical muscle situated close to the midline).
5. aponeurosis of the internal oblique muscle.

Fig.(19): ORIGIN AND INSERTION OF
INTERNAL OBLIQUE MUSCLE

The muscle arises by fleshy fibres from 3 areas: thoracolumbar fascia, anterior 2/3 of the intermediate area of iliac crest and lateral 2/3 of the concave upper surface of the inguinal ligament. It is inserted partly by fleshy fibres into 10th, 11th and 12th ribs and partly by aponeurosis into 7th, 8th and 9th ribs, linea alba and pubic crest.

(a) Areas of origin and insertion:

1. origin from thoracolumbar fascia.
2. origin from anterior 2/3 of intermediate area of iliac crest.
3. origin from lateral 2/3 of inguinal ligament.
4. insertion into pubic crest and medial part of pecten pubis (by conjoint tendon).
5. insertion into linea alba.
6. insertion into 7th, 8th, 9th ribs (aponeurotic).
7. insertion into 10th, 11th, 12th ribs (fleshy).

(b) Arrangement of fibres of internal oblique:

1. ribs 7, 8, 9 receiving the insertion of the upper part of the aponeurosis.
2. ribs 10, 11, 12 receiving the fleshy insertion of the most posterior fibres of the muscle.
3. posterior fibres arising from thoracolumbar fascia.
4. intermediate fibres arising from the iliac crest.
5. anterior fibres arising from the inguinal ligament.
6. conjoint tendon.
7. linea alba receiving the insertion of most of the aponeurosis.

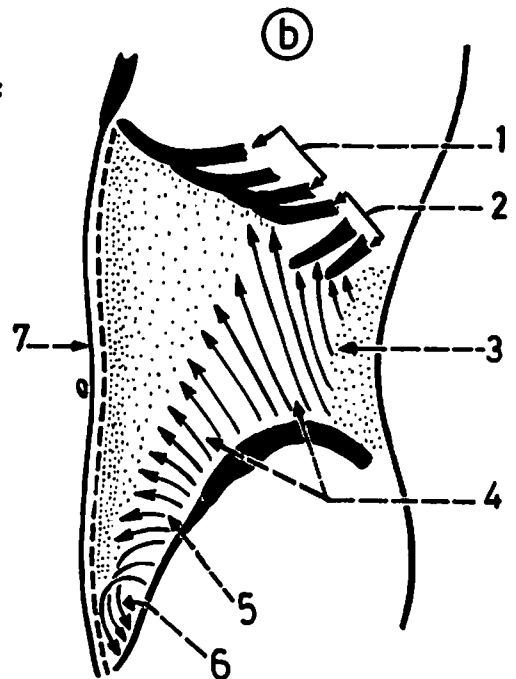
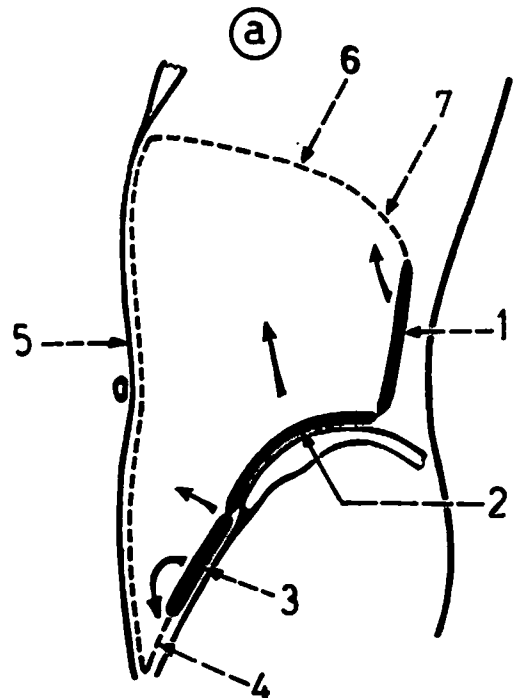


Fig.(20): CONJOINT TENDON

It is formed by fusion of the lower parts of the aponeuroses of the internal oblique and transversus abdominis muscles. It is attached to the pubic crest and the medial part of the pecten pubis.

1. inguinal ligament.
2. arched anterior fleshy fibres of internal oblique (form the roof of the inguinal canal).
3. conjoint tendon.
4. linea alba.
5. pubic crest and medial part of pecten pubis.

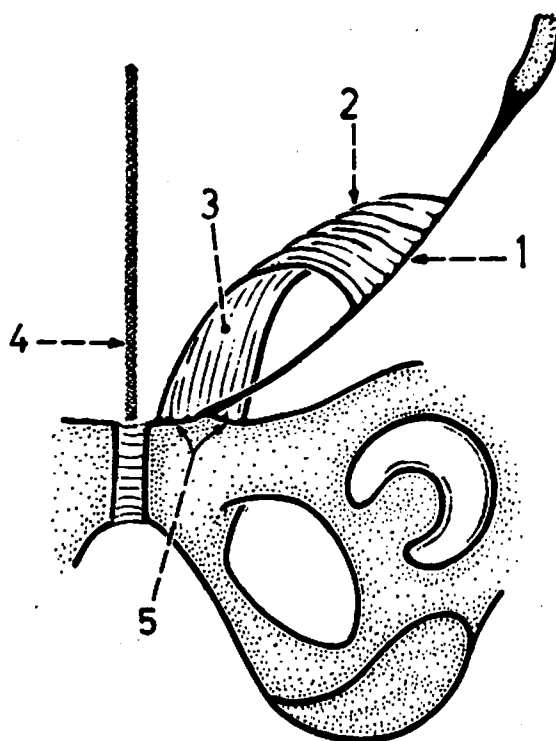
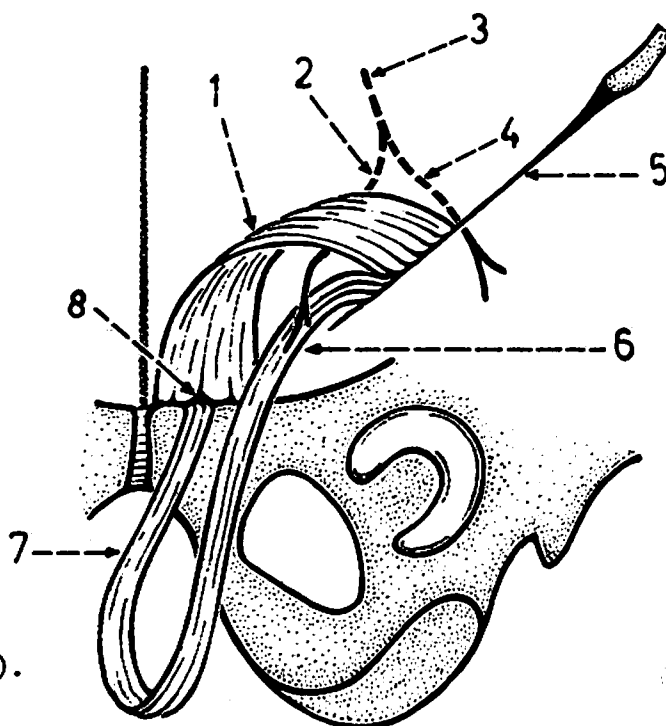


Fig.(21): CREMASTER MUSCLE

It is the muscle which suspends and elevates the spermatic cord and testis. It is U-shaped with its 2 ends attached to the inguinal ligament laterally and the pubic tubercle medially.

1. arched fleshy anterior fibres of internal oblique.
2. genital branch of genitofemoral nerve (supplies the cremaster muscle).
3. genitofemoral nerve.
4. femoral branch of genitofemoral nerve.
5. inguinal ligament.
6. lateral part of cremaster muscle (arises from the inguinal ligament).
7. medial part of cremaster muscle (attached to pubic tubercle).
8. pubic tubercle.



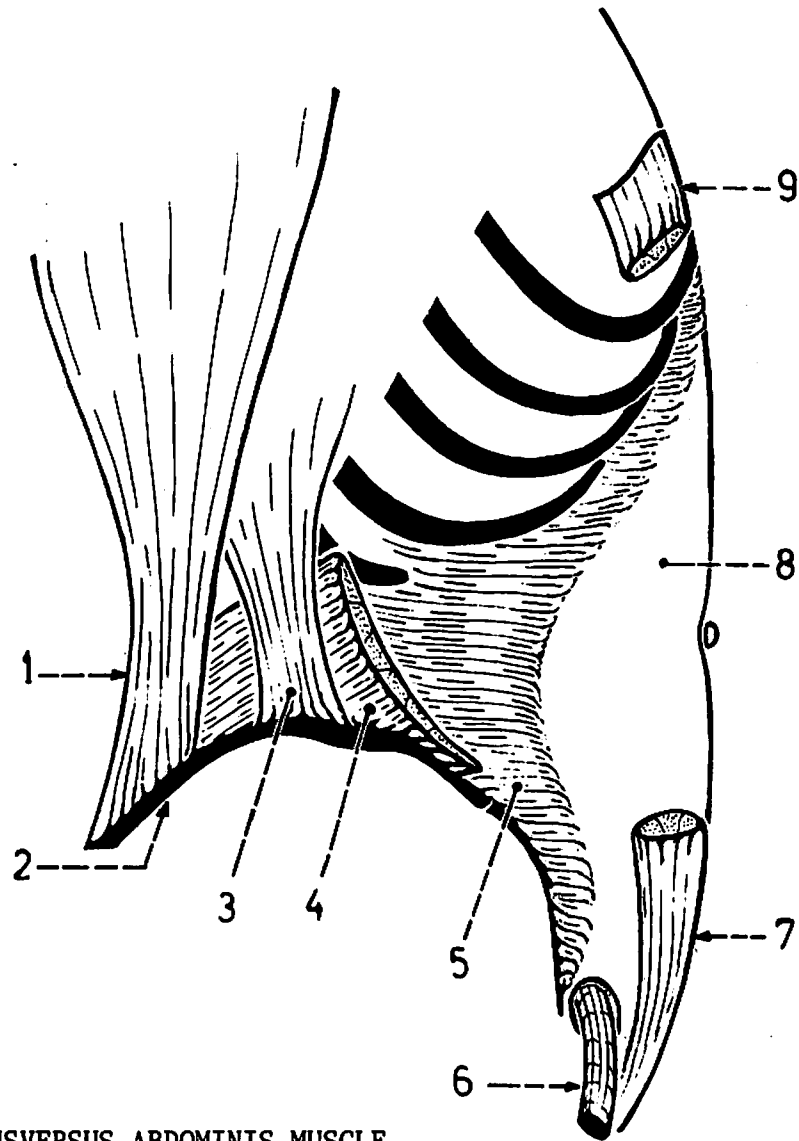


Fig.(22): TRANSVERSUS ABDOMINIS MUSCLE

It is the innermost of the 3 flat muscles of the anterolateral wall of the abdomen. Its fibres are arranged transversely.

1. latissimus dorsi.
2. iliac crest.
3. part of the external oblique muscle.
4. part of the internal oblique muscle (deep to the external oblique).
5. fleshy part of the transversus abdominis (deep to the internal oblique).
6. spermatic cord.
7. lower part of rectus abdominis muscle.
8. aponeurosis of transversus abdominis muscle.
9. upper part of rectus abdominis muscle.

Fig.(23): ORIGIN AND INSERTION OF TRANSVERSUS ABDOMINIS MUSCLE

The muscle arises by fleshy fibres from 4 areas: lower 6 costal cartilages, thoracolumbar fascia, anterior 2/3 of inner lip of the iliac crest and lateral 1/3 of the grooved upper surface of the inguinal ligament. It is inserted by an aponeurosis into the linea alba and through the conjoint tendon into the pubic crest and pecten pubis.

1. origin from lower 6 costal cartilages (it interdigitates with the origin of diaphragm).
2. origin from thoracolumbar fascia.
3. origin from anterior 2/3 of inner lip of iliac crest.
4. origin from lateral 1/3 of inguinal ligament.
5. insertion into linea alba.
6. insertion into pubic crest and pecten pubis (by conjoint tendon).

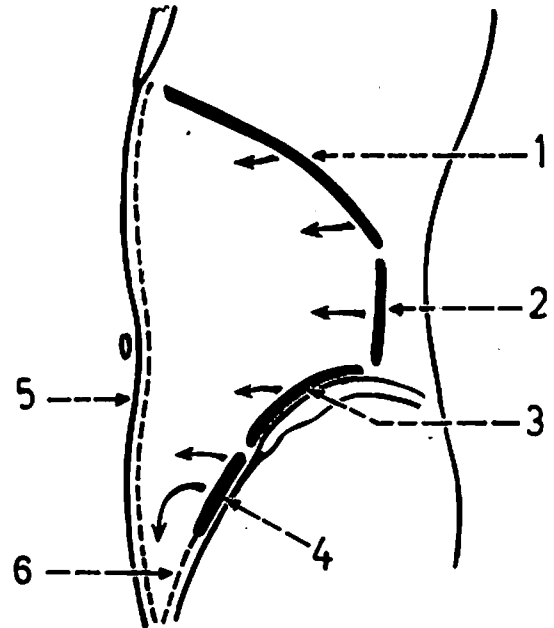


Fig.(24): FLESHY AND APONEUROTIC PARTS OF TRANSVERSUS ABDOMINIS MUSCLE

The fleshy fibres of the muscle run transversely and end in an aponeurosis. This aponeurosis differs from the other 2 aponeuroses in that its upper part is narrow where the fleshy fibres reach as far as 2-3 cm from the midline.

1. thoracolumbar fascia.
2. transverse fleshy fibres.
3. conjoint tendon.
4. aponeurosis of transversus abdominis.
5. uppermost narrow part of the aponeurosis.
6. uppermost fleshy fibres of the muscle reaching 2-3 cm from the midline.

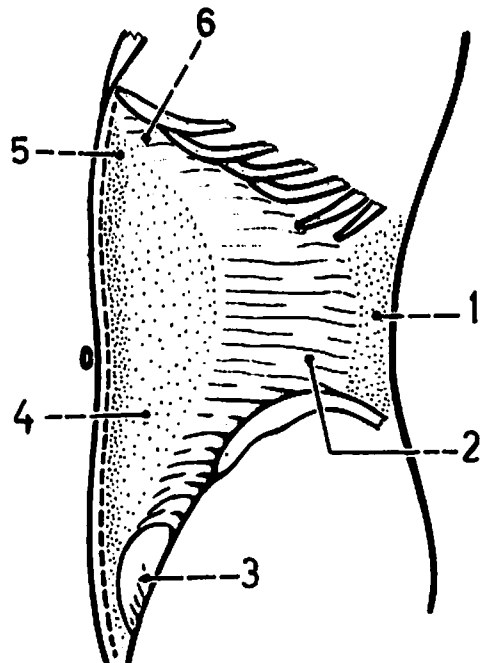


Fig.(25): RELATIONS OF THE CONJOINT TENDON

The conjoint tendon forms part of the posterior wall of the inguinal canal where it lies behind the spermatic cord. It also lies in front of the lower part of the rectus abdominis muscle.

1. linea alba.
2. lower part of rectus abdominis muscle.
3. reflected part of inguinal ligament (forms part of the posterior wall of inguinal canal in front of the conjoint tendon; it runs upwards and medially to reach the linea alba).
4. conjoint tendon.
5. inguinal ligament.
6. spermatic cord.

* Remember that the conjoint tendon is formed by the fusion of the lower parts of the aponeuroses of the internal oblique and transversus abdominis.

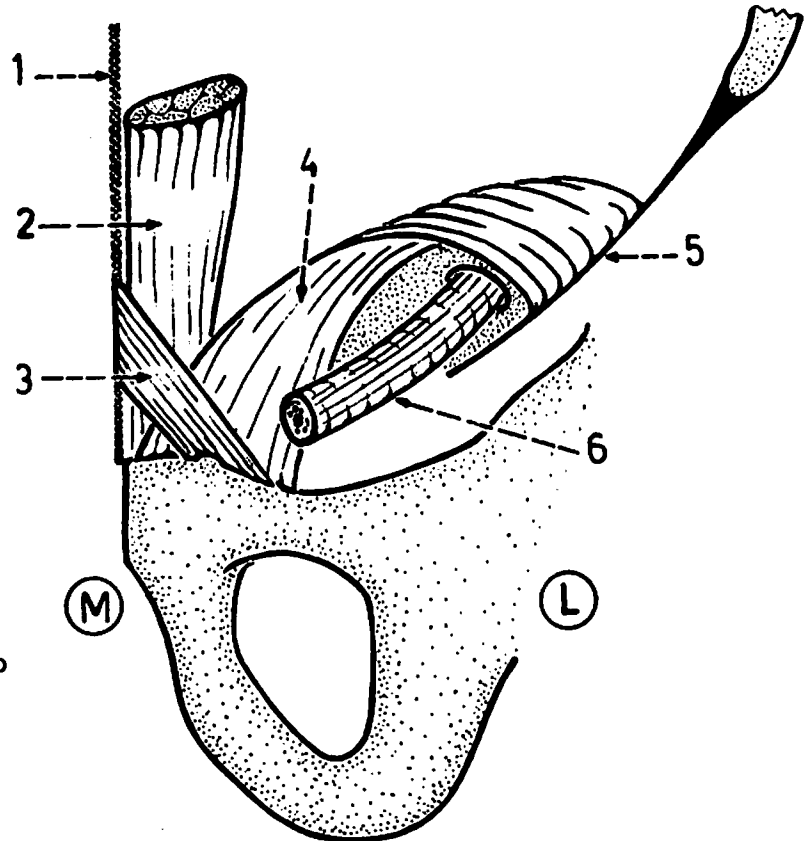


Fig.(26): ARRANGEMENT OF FIBRES OF THE THREE FLAT MUSCLES OF THE ANTEROLATERAL ABDOMINAL WALL

1. direction of fibres of the external oblique: downwards, forwards and medially.
2. direction of fibres of the internal oblique: upwards, forwards and medially.
3. direction of fibres of the transversus abdominis: run transversely.

* This arrangement of the fibres of the 3 muscles gives strength to the abdominal wall.

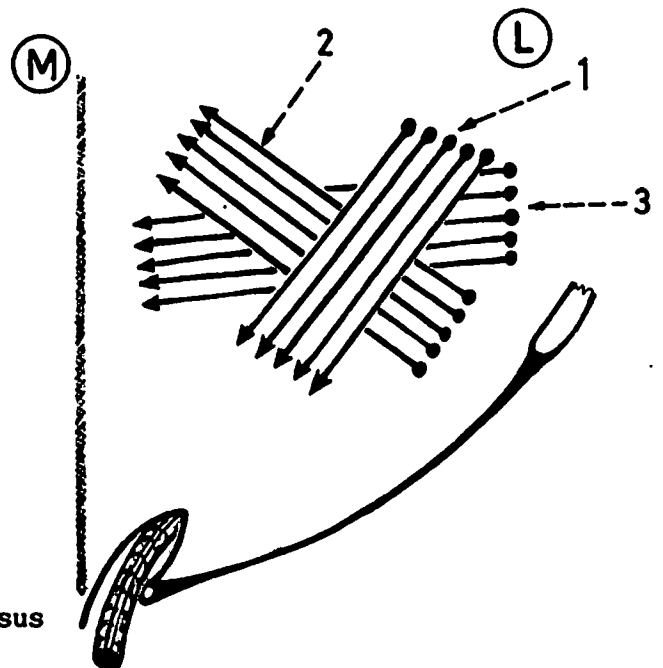
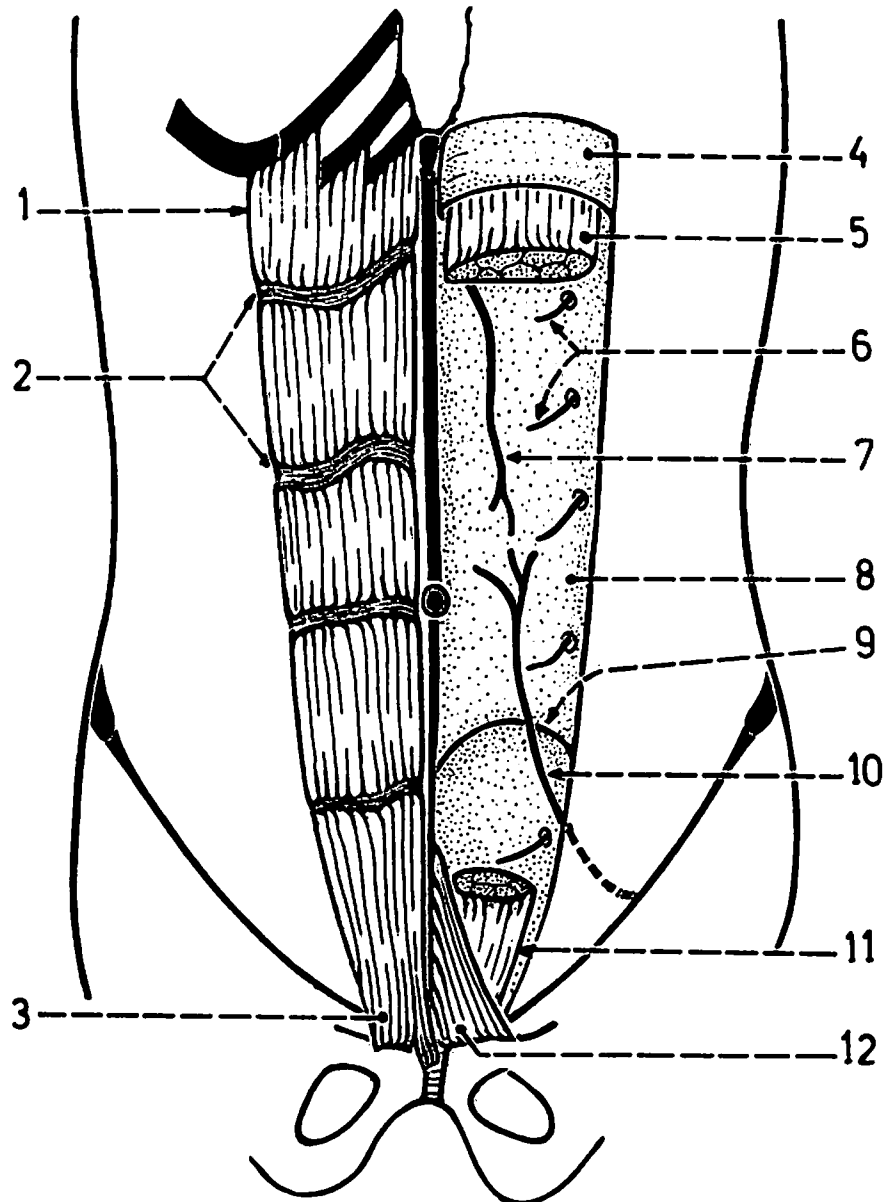


Fig.(27): RECTUS ABDOMINIS MUSCLE

It is a long flat muscle which lies one on each side of the linea alba. It is ensheathed by a fibrous envelop called rectus sheath. It is narrow in its lower part where it arises from the pubic crest and symphysis pubis. It is wider in its upper part where it is inserted into the 5th, 6th and 7th costal cartilages. Its fibres are interrupted by 3-4 transverse fibrous bands called tendinous intersections.

1. insertion of rectus abdominis muscle.
2. tendinous inter-sections.
3. origin of rectus abdominis.
4. anterior wall of rectus sheath (cut).
5. upper part of rectus abdominis (cut to show the contents of the rectus sheath).
6. lower intercostal nerves (piercing the posterior wall of the rectus sheath).
7. superior epigastric artery.
8. posterior wall of rectus sheath.
9. arcuate line.
10. inferior epigastric artery.
11. lower part of rectus abdominis (cut).
12. pyramidalis muscle (a small triangular muscle situated in front of the lower part of the rectus abdominis).



* Note that the linea alba is narrow below the umbilicus but wider above the umbilicus.

Fig.(28): BORDERS OF RECTUS ABDOMINIS

The medial border of the muscle is straight and lies parallel and close to the linea alba, while the lateral border is slightly convex and is marked on the surface by a curved line termed linea semilunaris. The linea alba is a longitudinal tendinous raphe extending in the midline from the xiphoid process to the symphysis pubis. It is broader above the umbilicus than below it.

1. medial border of rectus abdominis (straight).
2. linea alba.
3. pubic tubercle.
4. lateral border of rectus abdominis (convex laterally).
5. linea semilunaris (extends from the 9th costal cartilage to the pubic tubercle and corresponds to the lateral border of rectus abdominis).
6. 9th costal cartilage.
7. line of insertion of rectus abdominis into the 5th, 6th and 7th costal cartilages.

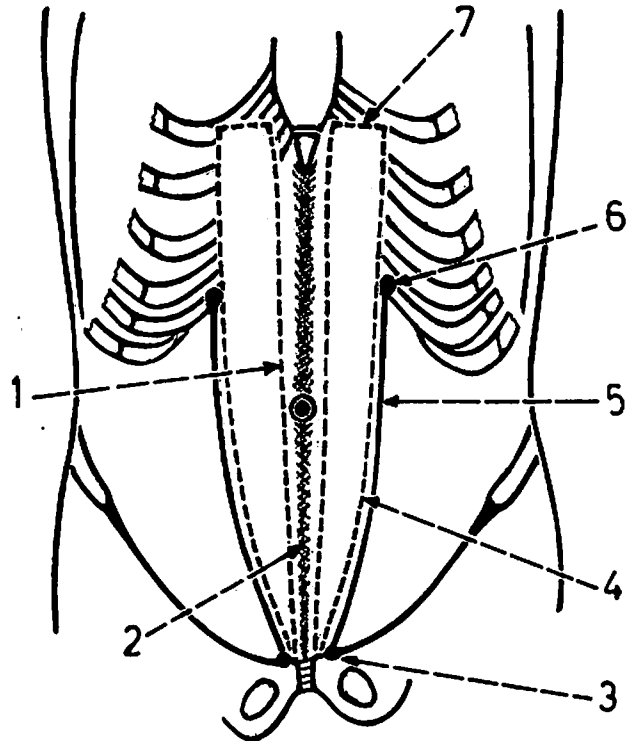


Fig.(29): PYRAMIDALIS MUSCLE

It is a small triangular muscle situated within the rectus sheath in front of the lower part of the rectus abdominis. It arises from the front of the pubis and symphysis pubis and is inserted into the lower part of the linea alba.

1. rectus abdominis.
2. subcostal nerve supplying the pyramidalis.
3. pyramidalis muscle.
4. linea alba.

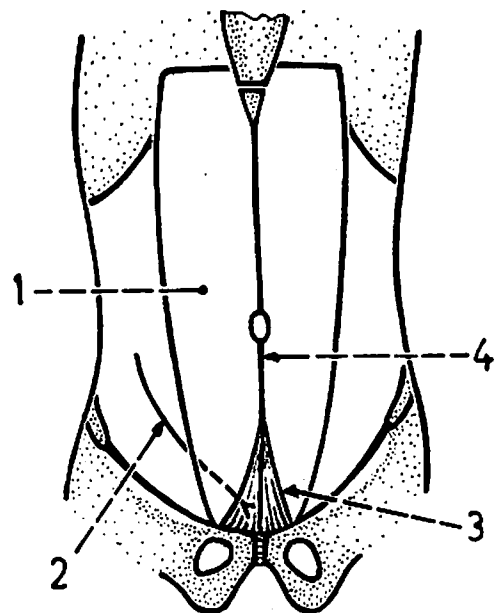


Fig.(30): RECTUS ABDOMINIS AND RECTUS SHEATH (side view, L.S.)

The rectus abdominis is enclosed within the rectus sheath. This fibrous sheath has anterior and posterior walls the formation of which is not the same all through. The sheath is described at 3 levels as follows:

Level (a): the part above the costal margin.

- * anterior wall: formed by aponeurosis of external oblique.
- * posterior wall: formed by costal cartilages of 5, 6, 7 ribs.

Level (b): the part from the costal margin to midway between umbilicus and symphysis pubis.

- * anterior wall: formed by aponeurosis of external oblique and 1/2 of aponeurosis of internal oblique.
- * posterior wall: formed by aponeurosis of transversus abdominis and 1/2 of aponeurosis of internal oblique.

Level (c): the part below level (b).

- * anterior wall: formed by the aponeuroses of the 3 muscles.
- * posterior wall: formed by transversalis fascia.

1. aponeurosis of external oblique.
2. rectus abdominis.
3. aponeurosis of external oblique and 1/2 that of internal oblique.
4. all the 3 aponeuroses.
5. symphysis pubis.
6. the 5th, 6th, 7th costal cartilages.
7. superior epigastric artery.
8. parietal peritoneum.
9. transversalis fascia.
10. extraperitoneal tissue.
11. aponeurosis of transversus abdominis and 1/2 that of internal oblique.
12. inferior epigastric artery.

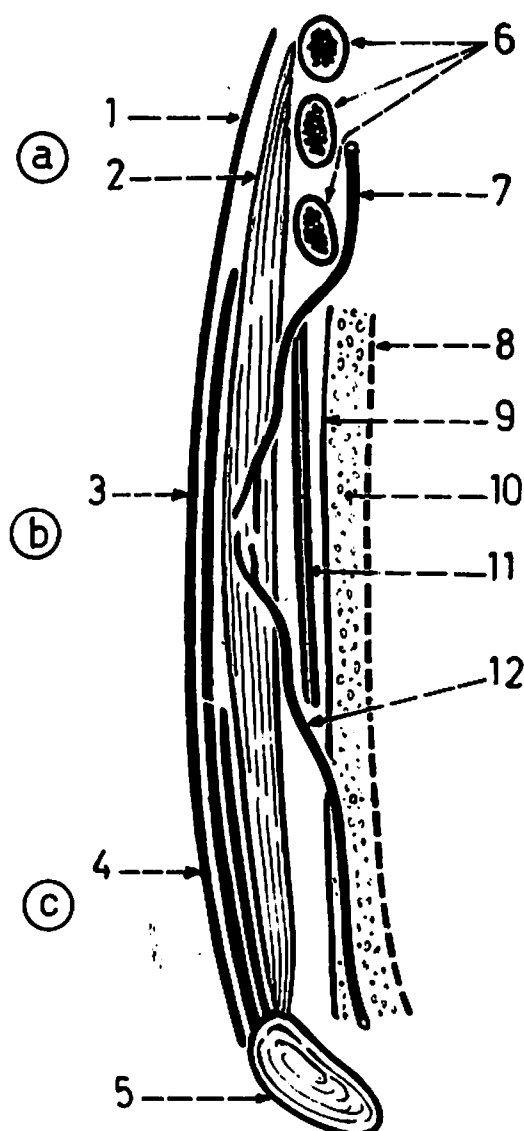
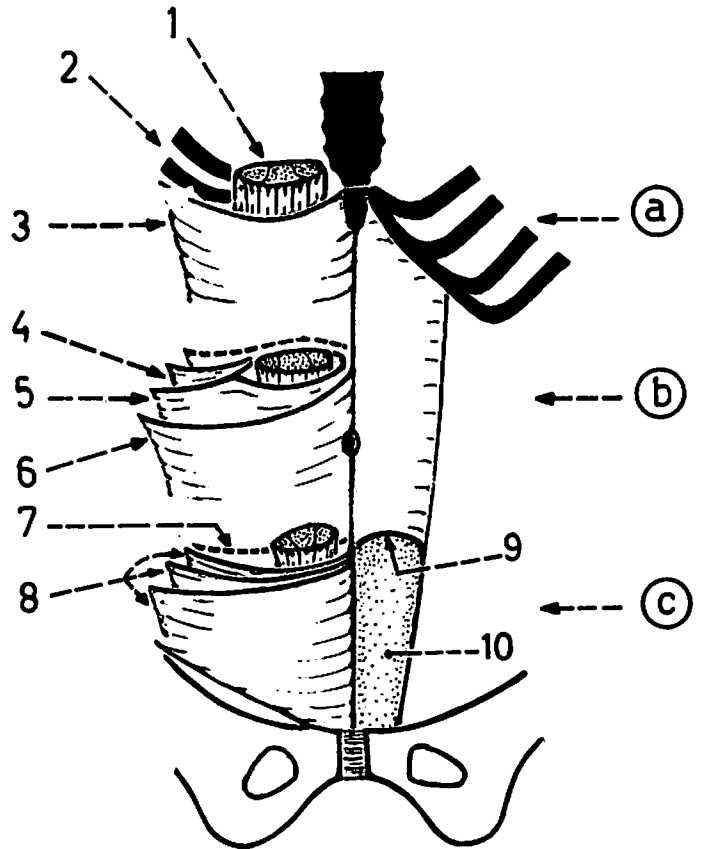


Fig.(31): FORMATION OF RECTUS SHEATH AT VARIOUS LEVELS (T.S.)

Level (a): the part above the costal margin.

Level (b): the part from the costal margin to mid-way between the umbilicus and symphysis pubis.

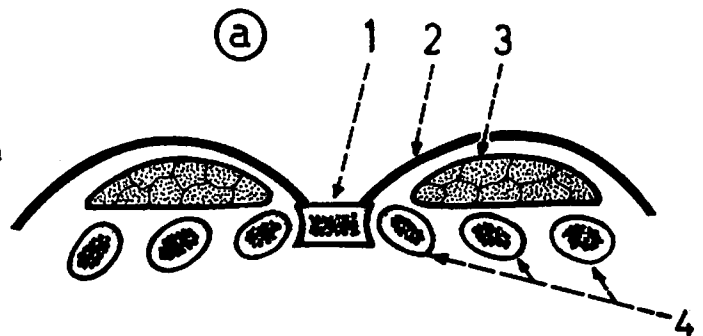
Level (c): the part below the line midway between the umbilicus and symphysis pubis (this line corresponds to the arcuate line in the posterior wall of the sheath).



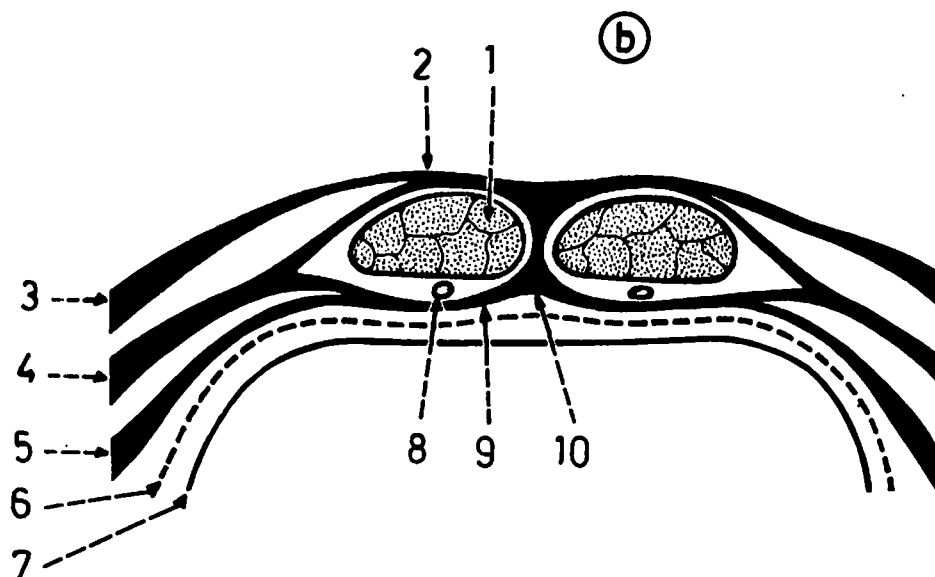
1. upper part of rectus abdominis.
2. costal cartilages behind the muscle.
3. aponeurosis of external oblique.
4. aponeurosis of transversus abdominis.
5. aponeurosis of internal oblique (splitted).
6. aponeurosis of external oblique.
7. transversalis fascia.
8. the 3 aponeuroses.
9. arcuate line in the posterior wall of the sheath.
10. transversalis fascia.

Fig.(32): DETAILS OF RECTUS SHEATH AT VARIOUS LEVELS (T.S.)

Level (a): upper part of the sheath above the costal margin.

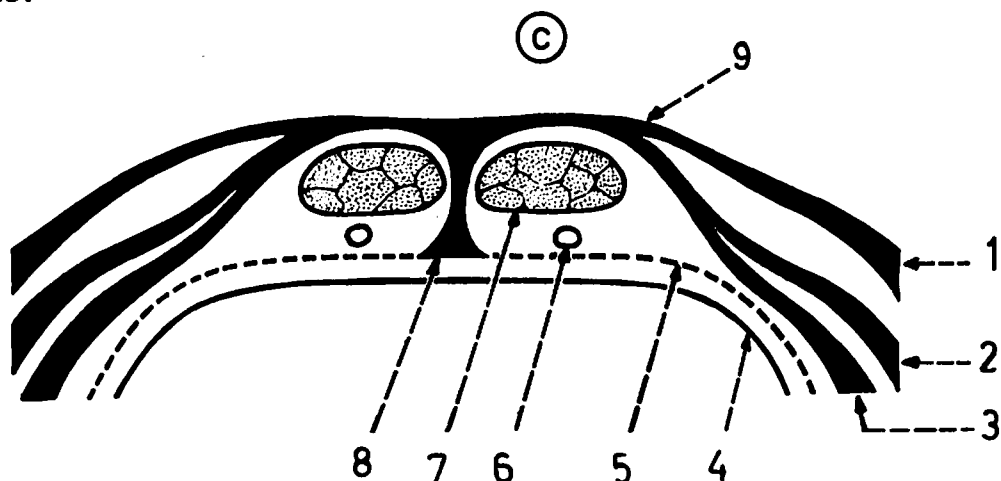


1. sternum.
2. aponeurosis of external oblique forming the anterior wall of the sheath.
3. rectus abdominis.
4. the 5th, 6th and 7th costal cartilages forming the posterior wall of the sheath.



Level (b): middle part of the sheath extending from costal margin to the arcuate line.

- | | |
|--|-------------------------------------|
| 1. rectus abdominis. | 6. transversalis fascia. |
| 2. anterior wall of rectus sheath. | 7. parietal peritoneum. |
| 3. aponeurosis of external oblique. | 8. superior epigastric artery. |
| 4. aponeurosis of internal oblique (splitted). | 9. posterior wall of rectus sheath. |
| 5. aponeurosis of transversus abdominis. | 10. linea alba. |



Level (c): lower part of the sheath below the arcuate line.

- | | |
|--|---|
| 1. aponeurosis of external oblique. | 5. transversalis fascia forming the posterior wall of the sheath. |
| 2. aponeurosis of internal oblique (unsplitted). | 6. inferior epigastric artery. |
| 3. aponeurosis of transversus abdominis. | 7. rectus abdominis. |
| 4. parietal peritoneum. | 8. linea alba. |
| | 9. anterior wall of rectus sheath. |

* Note that the contents of the sheath are: rectus abdominis, pyramidalis, superior and inferior epigastric arteries and the lower 6 thoracic nerves.

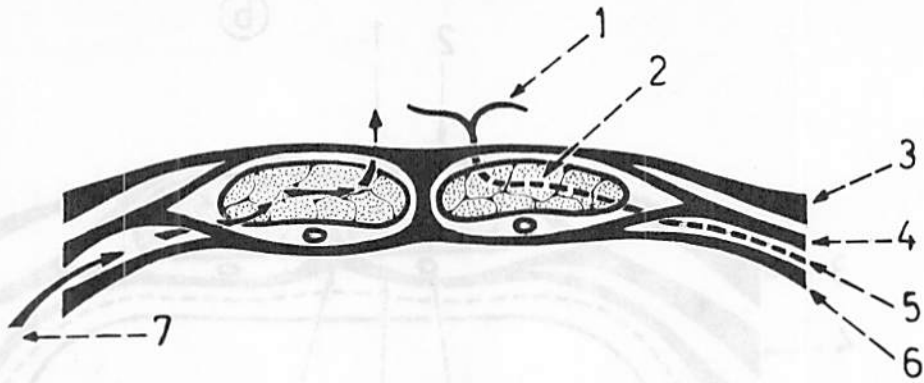


Fig.(33): COURSE OF THORACIC NERVES IN THE RECTUS SHEATH

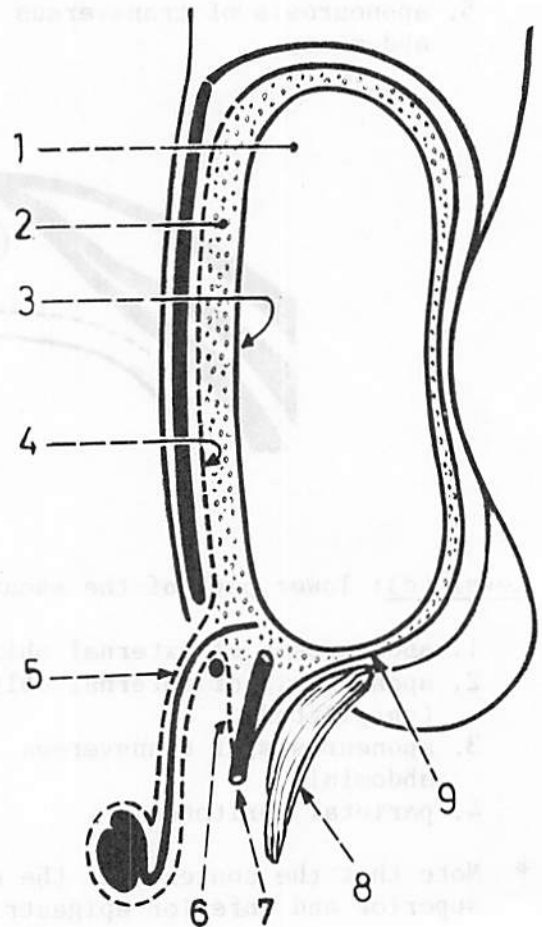
The rectus sheath contains the terminations of the lower 6 thoracic nerves. These nerves enter the sheath by piercing its posterior wall and then run through the rectus abdominis from lateral to medial. They leave the muscle to pierce the anterior wall of the sheath and become the anterior cutaneous nerves.

- | | |
|-------------------------------------|--|
| 1. anterior cutaneous nerve. | 5. a lower thoracic nerve. |
| 2. rectus abdominis. | 6. aponeurosis of transversus abdominis. |
| 3. aponeurosis of external oblique. | 7. course of the nerve. |
| 4. aponeurosis of internal oblique. | |

Fig.(34): TRANSVERSALIS FASCIA

It is a membrane which lines the transversus abdominis muscle and has 2 prolongations outside the abdominal cavity: the internal spermatic fascia and the anterior wall of the femoral sheath.

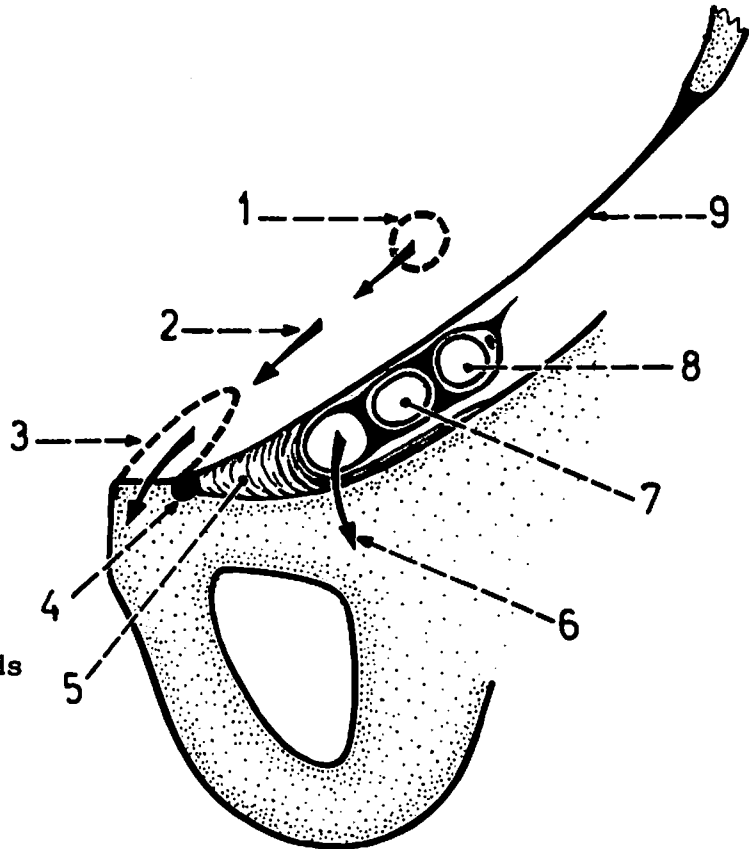
- | |
|--|
| 1. abdominal cavity. |
| 2. extraperitoneal tissue. |
| 3. parietal peritoneum. |
| 4. transversalis fascia. |
| 5. internal spermatic fascia (it is a prolongation from the transversalis fascia around the spermatic cord). |
| 6. anterior wall of femoral sheath. |
| 7. femoral vessel (within the femoral sheath). |
| 8. iliopsoas muscle. |
| 9. fascia iliaca (covers the iliacus muscle and extends downwards to form the posterior wall of the femoral sheath). |



INGUINAL CANAL AND INGUINAL HERNIA

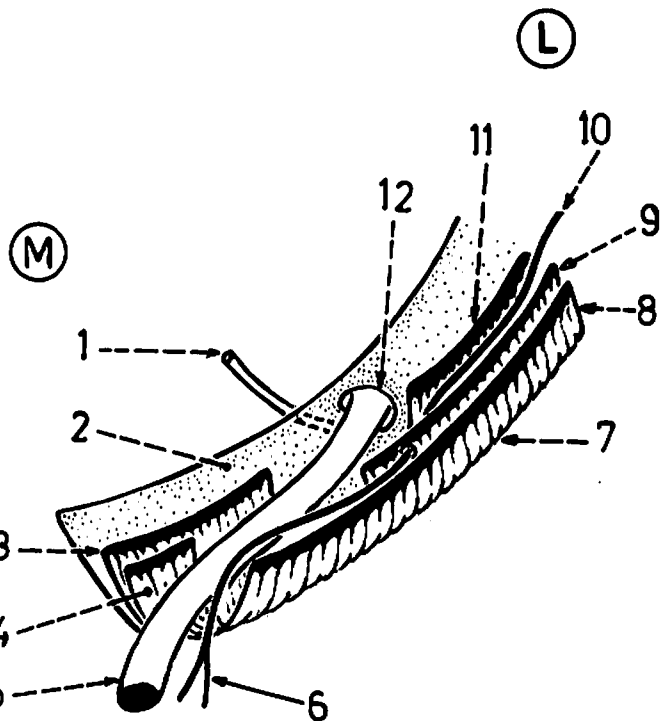
Fig.(35): POSITION OF THE INGUINAL CANAL

The inguinal canal is an oblique passage which passes through the lower part of the anterior abdominal wall, just above and parallel to the medial 1/2 of the inguinal ligament. It extends from the deep inguinal ring to the superficial inguinal ring, and is the route for inguinal hernia.



1. deep inguinal ring (corresponds to the midinguinal point).
2. course of inguinal canal.
3. superficial inguinal ring.
4. pubic tubercle.
5. lacunar ligament.
6. femoral canal.
7. femoral vein.
8. femoral artery.
9. inguinal ligament.

Fig.(36): WALLS AND CONTENTS OF INGUINAL CANAL IN THE MALE

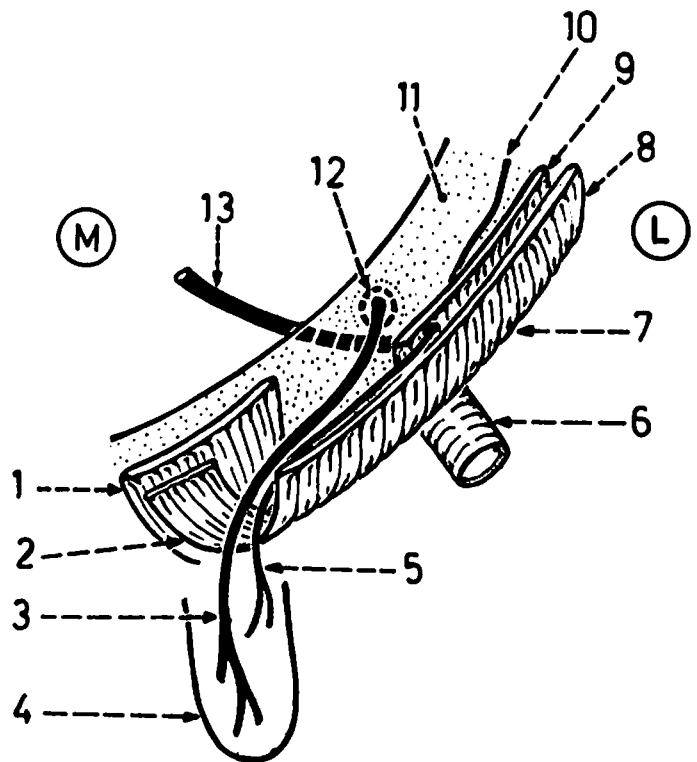


1. inferior epigastric artery.
2. transversalis fascia.
3. conjoint tendon.
4. reflected part of inguinal ligament.
5. spermatic cord.
6. ilioinguinal nerve.
7. inguinal ligament.
8. aponeurosis of external oblique.
9. internal oblique (fleshy).
10. ilioinguinal nerve.
11. transversus abdominis (fleshy).
12. deep inguinal ring.

* The inguinal canal has anterior wall, posterior wall, roof and floor.

Fig.(37): WALLS AND CONTENTS OF
INGUINAL CANAL IN
THE FEMALE

1. conjoint tendon.
2. reflected part of inguinal ligament.
3. round ligament of uterus.
4. labium majus.
5. ilio-inguinal nerve.
6. femoral artery.
7. inguinal ligament.
8. aponeurosis of external oblique.
9. internal oblique (fleshy).
10. ilio-inguinal nerve.
11. transversalis fascia.
12. deep inguinal ring.
13. inferior epigastric artery.



- * Anterior wall: formed by the aponeurosis of external oblique (all through) and fleshy fibres of internal oblique (in lateral 1/3).
- * Posterior wall: formed by transversalis fascia (all through), conjoint tendon (in medial 1/3) and reflected part of inguinal ligament (in medial 1/4).
- * Floor: formed by the grooved upper surface of the inguinal ligament.
- * Roof: formed by the arched fleshy fibres of both the internal oblique and transversus abdominis.
- * Contents: in the male it contains the spermatic cord and ilio-inguinal nerve, while in the female the spermatic cord is replaced by the round ligament of the uterus.

Fig.(38): ROOF AND FLOOR OF INGUINAL CANAL

1. roof of the canal (arched fleshy fibres of internal oblique and transversus abdominis).
2. deep inguinal ring (an opening in the transversalis fascia).
3. conjoint tendon (in the posterior wall of the inguinal canal).
4. reflected part of the inguinal ligament (in the medial 1/4 of the posterior wall of the inguinal canal).
5. floor of the canal (formed by the grooved upper surface of the inguinal ligament).
6. convex lower surface of the inguinal ligament.

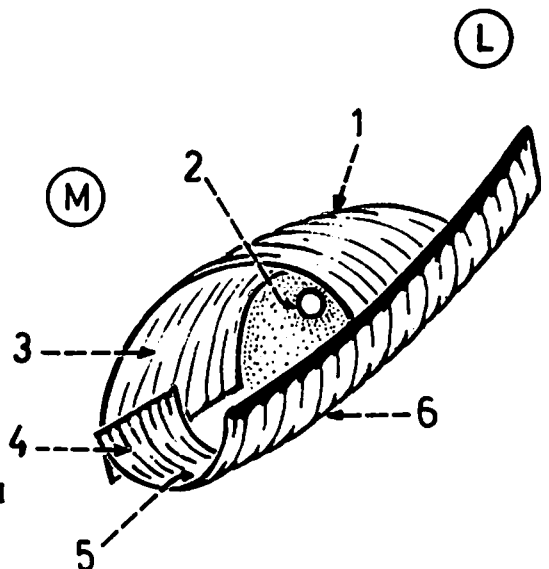


Fig.(39): SUPERFICIAL INGUINAL RING

It is a triangular aperture in the lower medial part of the aponeurosis of the external oblique, just above and medial to the pubic tubercle. It has a base, lateral crus and medial crus.

1. aponeurosis of external oblique.
2. intercrural fibres (curved fibres situated above the apex of the ring).
3. apex of the ring.
4. lateral crus (attached to the pubic tubercle).
5. pubic tubercle.
6. base of the ring (formed by the pubic crest).
7. reflected part of inguinal ligament seen through the ring.
8. medial crus (attached to the symphysis pubis).
9. linea alba.

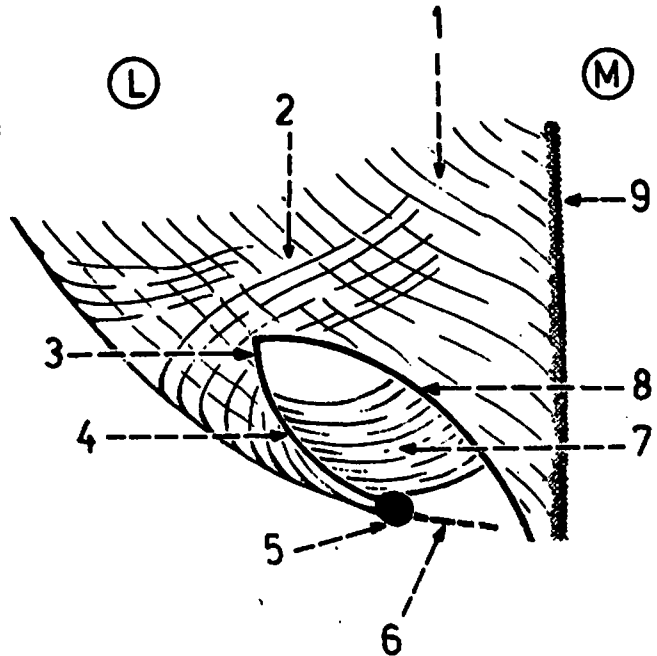
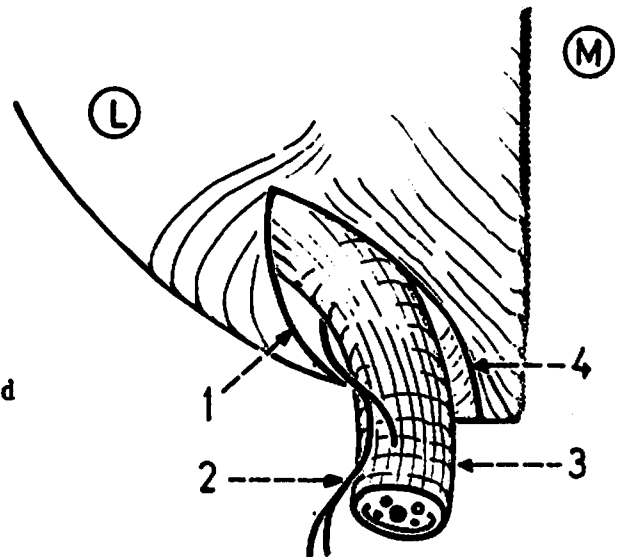


Fig.(40): STRUCTURES PASSING THROUGH THE SUPERFICIAL INGUINAL RING

These are the spermatic cord and ilio-inguinal nerve in the male, while in the female the cord is replaced by the round ligament of the uterus.

1. lateral crus of the ring (overlapped by the spermatic cord).
2. ilio-inguinal nerve (L.I).
3. spermatic cord passing to the testis in the scrotum.
4. medial crus of the ring.



* The margins of the ring give attachment to the external spermatic fascia which forms the outermost coat of the spermatic cord.

* The 2 crura can be felt in the living.

Fig.(41): STRUCTURES PASSING THROUGH THE DEEP INGUINAL RING

The deep ring is an opening in the transversalis fascia situated at the midinguinal point. It transmits the following structures in the male: ductus (vas) deferens, testicular vessels, artery of the vas, cremasteric artery, genital branch of genitofemoral nerve, lymphatic vessels and autonomic plexus of nerves.

1. pampiniform plexus of veins.
2. genital branch of genitofemoral nerve.
3. cremasteric artery.
4. deep inguinal ring.
5. ductus (vas) deferens.
6. testicular artery.
7. testicular vein.
8. artery of the vas.
9. superficial inguinal ring.

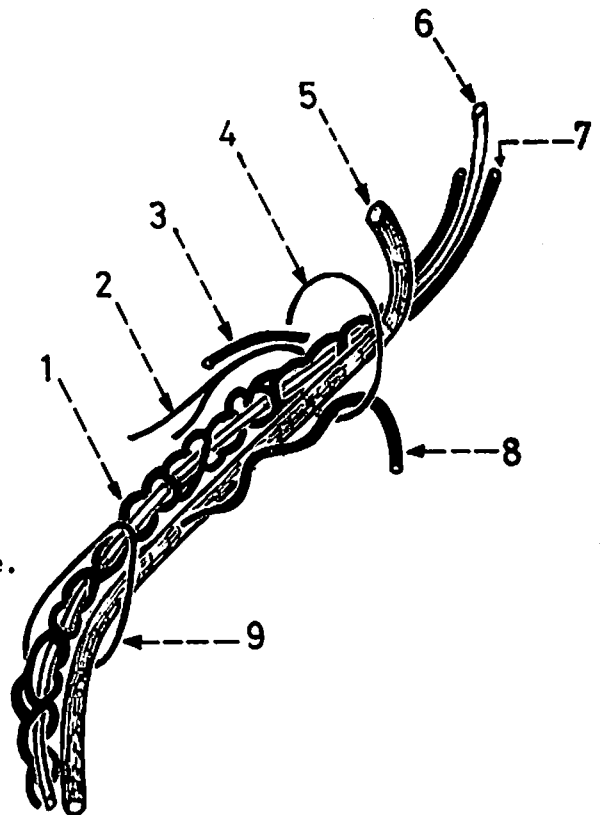


Fig.(42): PARTS OF HERNIA IN GENERAL

A hernia, in general, is a protrusion of an abdominal viscus (usually an intestinal loop) through a weak point in the anterior abdominal wall. A hernia consists of a hernial sac, coverings and contents; the hernial sac has a neck, fundus and cavity.

1. parietal peritoneum (forms the hernial sac).
2. fascia transversalis.
3. intestinal loop (may enter the cavity of the hernial sac).
4. neck of the hernial sac (the constricted proximal part of the sac).
5. fundus of the hernial sac (the distal expanded end of the hernial sac).
6. coverings of the hernial sac (all layers covering the hernial sac).

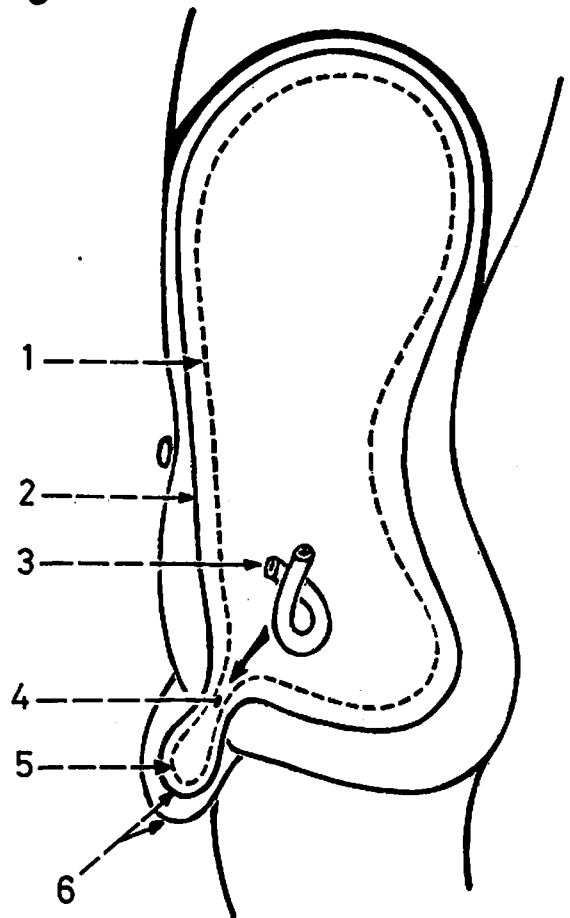


Fig.(43): COMMON SITES OF HERNIA

Hernia frequently occurs at the following weak sites in the anterior abdominal wall: inguinal canal (inguinal hernia), femoral canal (femoral hernia) and supra-umbilical part of linea alba or the umbilicus itself (umbilical hernia); the inguinal hernia is the most frequent.

1. supra-umbilical part of linea alba (umbilical or para-umbilical hernia).
2. umbilicus (umbilical hernia).
3. inguinal canal (inguinal hernia).
4. femoral canal (femoral hernia).

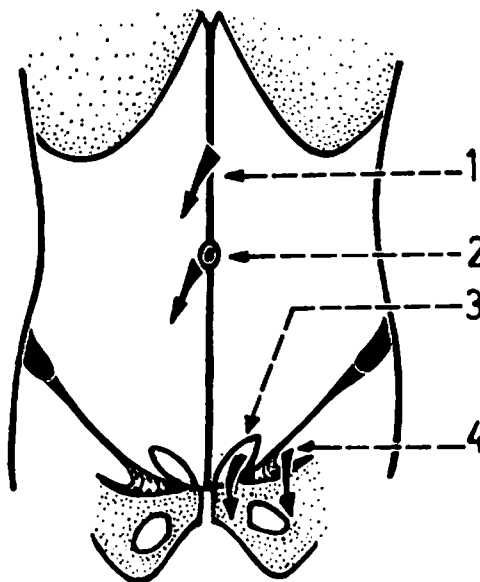


Fig.(44): INGUINAL HERNIA

Inguinal hernia is the protrusion of the hernial sac (parietal peritoneum) through the deep inguinal ring (oblique inguinal hernia) or through the posterior wall of the inguinal canal (direct inguinal hernia). The direct hernia may protrude through the lateral part of the posterior wall of inguinal canal formed by transversalis fascia (lateral direct hernia) or through its medial part formed by the conjoint tendon (medial direct hernia).

1. deep inguinal ring (site of oblique hernia).
2. inferior epigastric artery.
3. site of lateral direct hernia.
4. transversalis fascia.
5. site of medial direct hernia.
6. conjoint tendon.
7. reflected part of inguinal ligament.
8. cremaster muscle and fascia.
9. internal spermatic fascia.
10. external spermatic fascia.
11. anterior wall of inguinal canal.
12. internal oblique muscle.

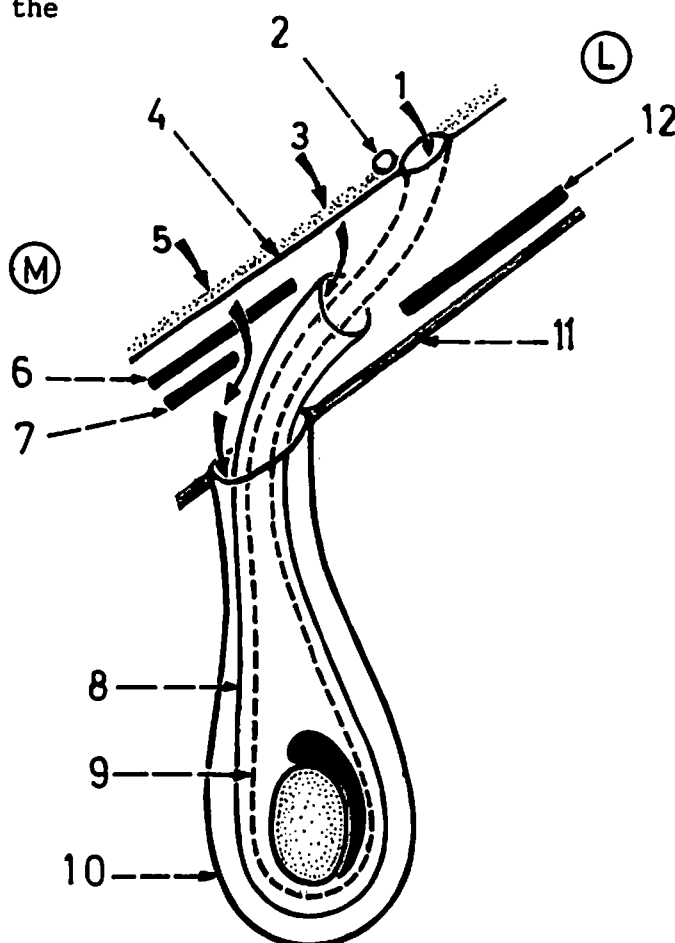
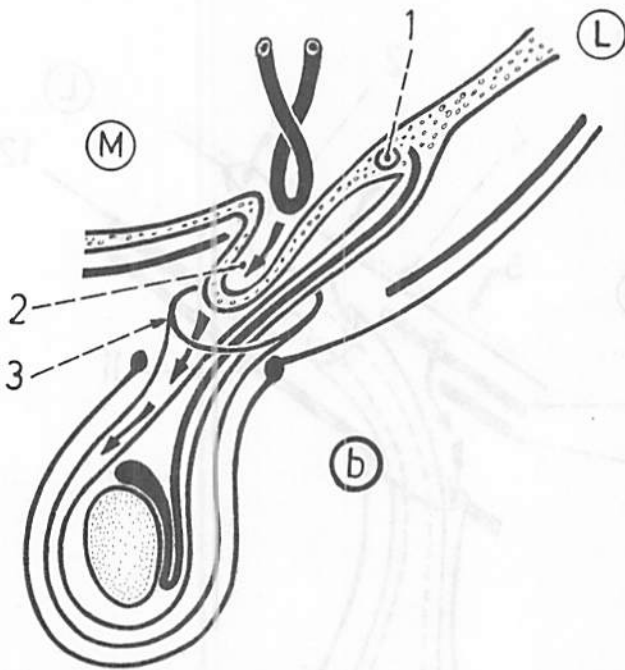
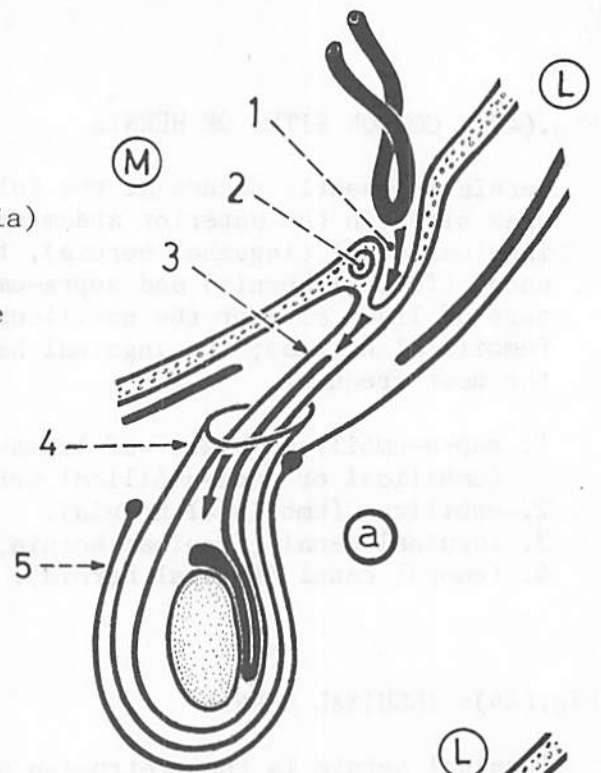


Fig.(45): TYPES OF INGUINAL HERNIA

(a) Oblique inguinal hernia: (indirect hernia)

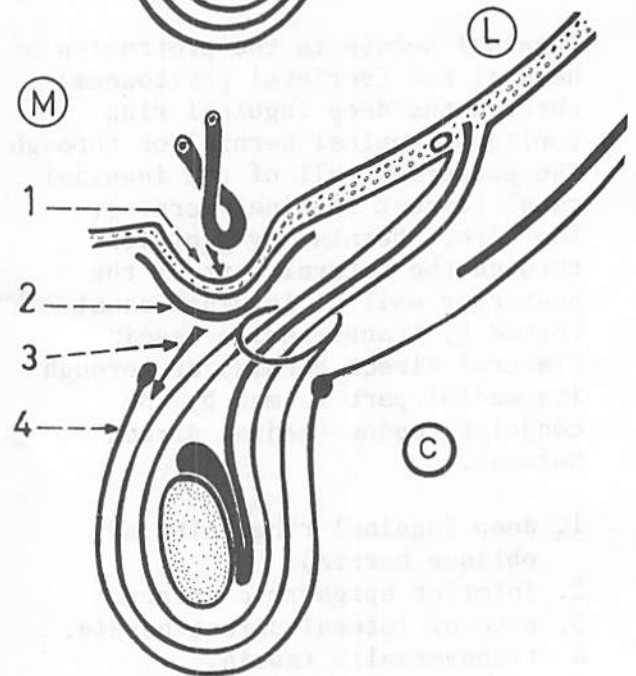
The hernial sac passes through the deep inguinal ring and will be covered by the internal spermatic fascia, then the cremaster muscle and fascia, then the external spermatic fascia. The neck of the sac is lateral to the inferior epigastric artery.

1. hernial sac.
2. inferior epigastric artery.
3. internal spermatic fascia.
4. cremaster muscle and fascia.
5. external spermatic fascia.

(b) Lateral direct inguinal hernia:

The hernial sac passes through the transversalis fascia in the lateral part of the posterior wall of the inguinal canal, medial to the inferior epigastric artery.

1. inferior epigastric artery.
2. hernial sac.
3. cremaster muscle and fascia.

(c) Medial direct inguinal hernia:

The hernial sac passes through the conjoint tendon in the medial part of the posterior wall of the inguinal canal.

1. hernial sac.
2. conjoint tendon.
3. course of the hernia deep to the external spermatic fascia.
4. external spermatic fascia.

BLOOD SUPPLY AND LYMPH DRAINAGE OF THE
ANTEROLATERAL WALL OF THE ABDOMEN

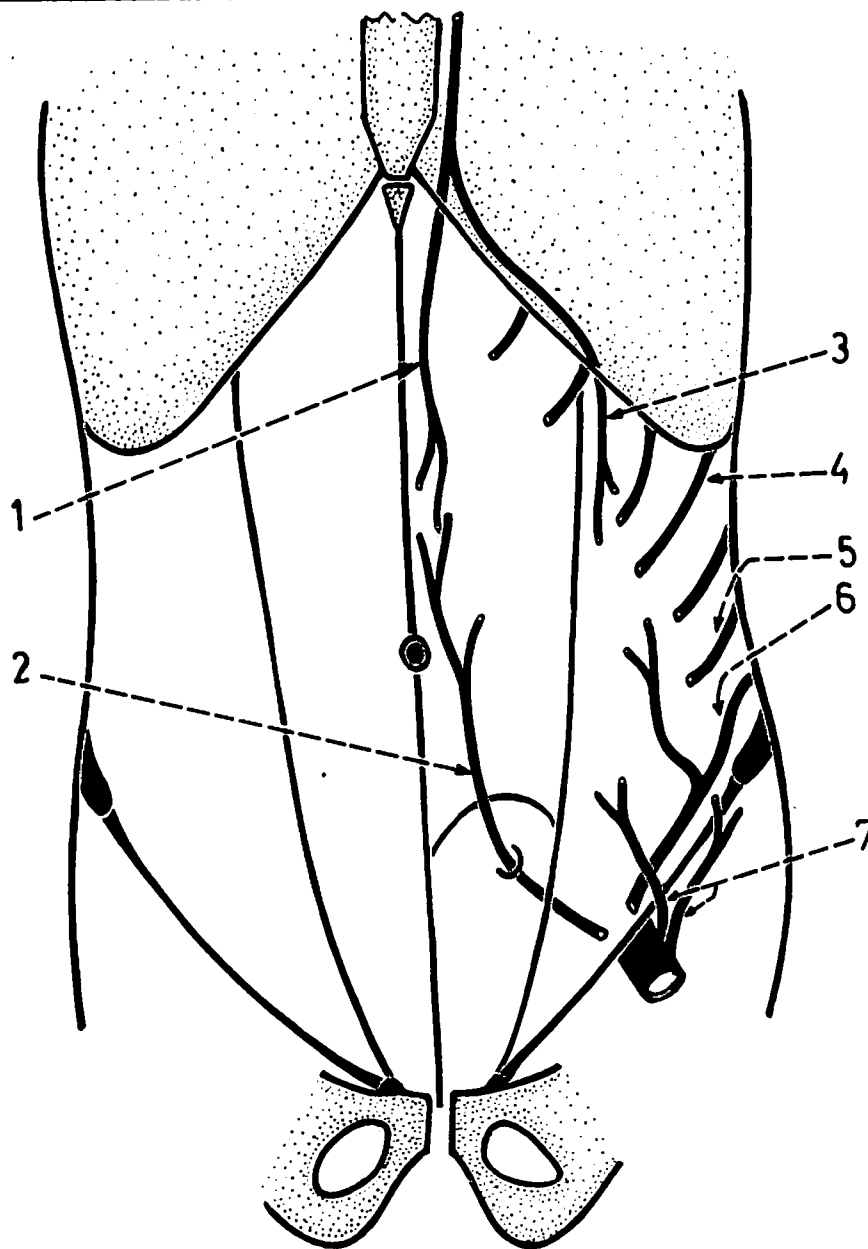


Fig.(46): ARTERIES OF THE ANTEROLATERAL WALL OF THE ABDOMEN

These arteries are: superior epigastric, inferior epigastric, deep circumflex iliac, lower posterior intercostal and lumbar arteries, in addition to the superficial arteries of the groin.

1. superior epigastric artery (from internal thoracic).
2. inferior epigastric artery (from external iliac).
3. musculophrenic artery (from internal thoracic).
4. lower posterior intercostal arteries (from descending thoracic aorta).
5. lumbar arteries (from abdominal aorta).
6. deep circumflex iliac artery (from external iliac).
7. superficial arteries of the groin (from femoral).

Fig.(47): SOURCES OF THE ARTERIES OF THE ANTEROLATERAL ABDOMINAL WALL

The arteries of the abdominal wall arise from the following arteries: subclavian artery(which gives off the internal thoracic), thoracic and abdominal aortae, external iliac and femoral.

1. subclavian artery.
2. aorta.
3. external iliac artery.
4. femoral artery.

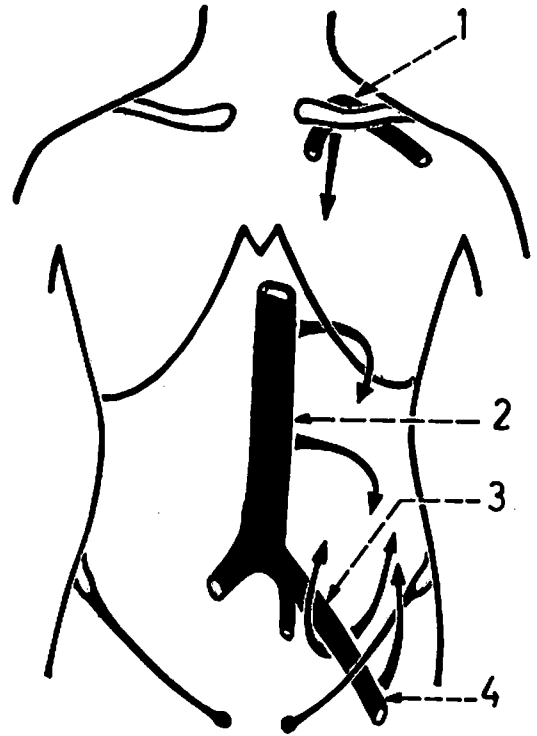


Fig.(48): ROLE OF EPIGASTRIC ARTERIES IN COARCTATION OF THE AORTA

In coarctation of the aorta (narrowing close to the aortic arch) collateral circulation is established through the anastomosis around the scapula and that between the epigastric arteries.

1. coarctation of the aorta.
2. direction of blood flow through the internal thoracic artery.
3. superior epigastric artery.
4. anastomosis between the 2 epigastric arteries within the rectus sheath.
5. inferior epigastric artery.

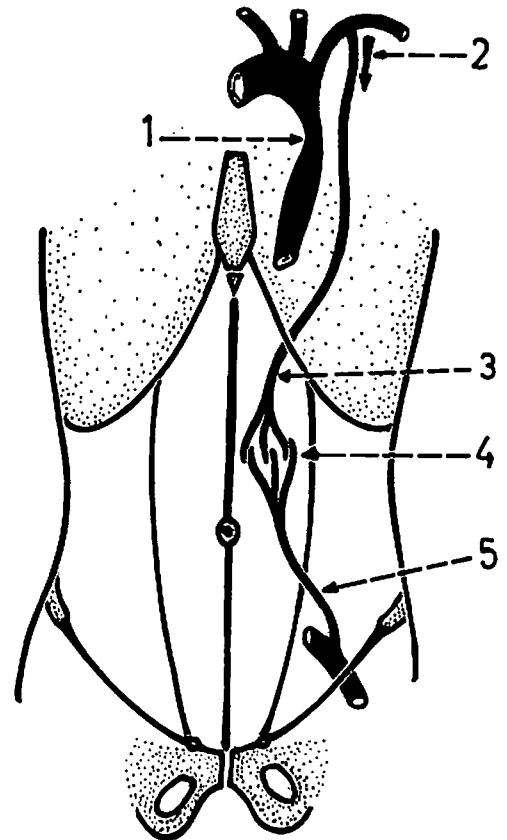
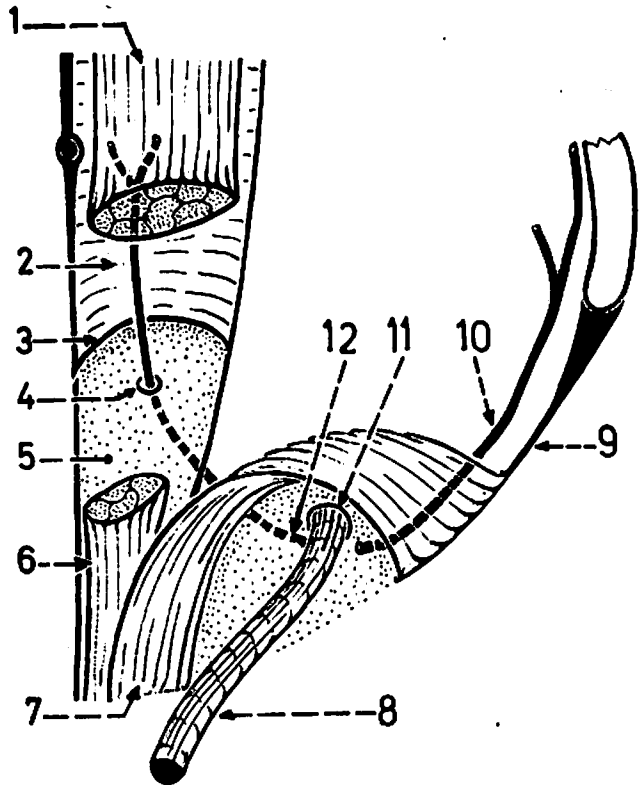


Fig.(49): INFERIOR EPIGASTRIC AND DEEP CIRCUMFLEX ILIAC ARTERIES

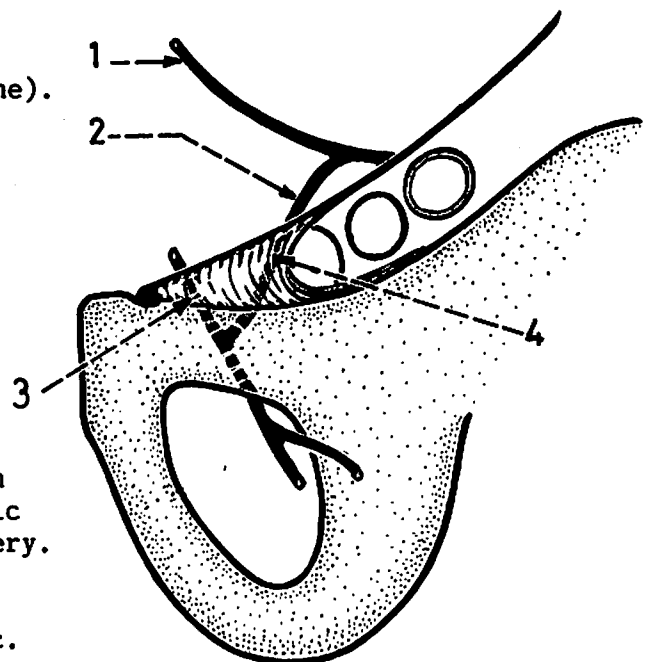
These 2 arteries arise from the terminal part of the external iliac artery just above the inguinal ligament. The inferior epigastric passes upwards and medially to enter the rectus sheath deep to the rectus abdominis, while the deep external iliac passes laterally behind and parallel to the inguinal ligament.



1. upper part of rectus abdominis.
2. posterior wall of rectus sheath.
3. arcuate line crossed by the inferior epigastric artery.
4. inferior epigastric artery piercing the transversalis fascia to enter the rectus sheath.
5. transversalis fascia.
6. lower part of rectus abdominis.
7. conjoint tendon.
8. spermatic cord.
9. inguinal ligament.
10. deep circumflex iliac artery (gives off an ascending branch at the anterior superior iliac spine).
11. deep inguinal ring.
12. inferior epigastric artery in the extraperitoneal tissue just medial to the deep inguinal ring.

Fig.(50): ABNORMAL OBTURATOR ARTERY

It is an abnormal artery formed in 30% of subjects as a result of enlargement of the anastomosis between the pubic branch of inferior epigastric and pubic branch of the obturator artery.



1. inferior epigastric artery.
2. pubic branch of inferior epigastric.
3. obturator artery.
4. abnormal obturator artery deep to the free edge of the lacunar ligament.

Fig.(51): VEINS OF THE ANTEROLATERAL ABDOMINAL WALL

These are mainly the superior epigastric, inferior epigastric, superficial epigastric and lateral thoracic veins. The veins above the umbilicus drain into the superior vena cava, while those below the umbilicus drain into the inferior vena cava.

The lateral thoracic vein anastomoses with the superficial epigastric in the superficial fascia to form the thoraco-epigastric vein, while the superior epigastric vein anastomoses with the inferior epigastric vein within the rectus sheath.

1. superior epigastric vein: a tributary of the internal thoracic vein (which drains into the subclavian vein and then the superior vena cava).
2. inferior epigastric vein: a tributary of the external iliac vein (which drains into the inferior vena cava).
3. great saphenous vein.
4. superficial epigastric vein: a tributary of the great saphenous vein (which joins the femoral vein and drains into the inferior vena cava).
5. lateral thoracic vein: a tributary of the axillary vein (which drains into the superior vena cava).

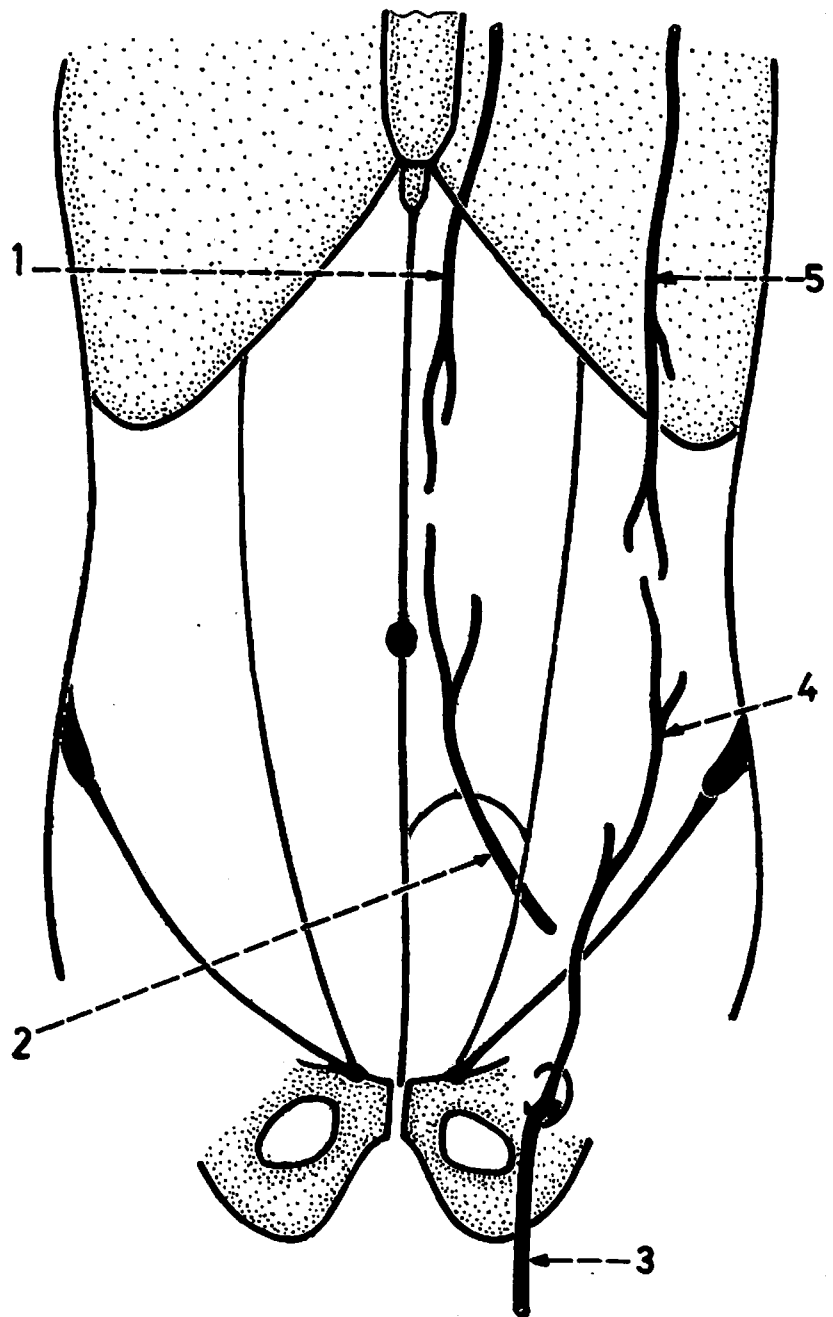


Fig.(52): PORTO-SYSTEMIC ANASTOMOSIS OF VEINS AROUND THE UMBILICUS

This is a venous anastomosis between tributaries of the portal vein represented by the para-umbilical veins (around the ligamentum teres of the liver) and systemic veins represented by the lateral thoracic and superficial epigastric veins (belong to the superior and inferior venae cavae).

1. lateral thoracic vein.
2. superficial epigastric vein.
3. radiating anastomosis around the umbilicus (its dilatation in portal obstruction forms what is called caput medusae).

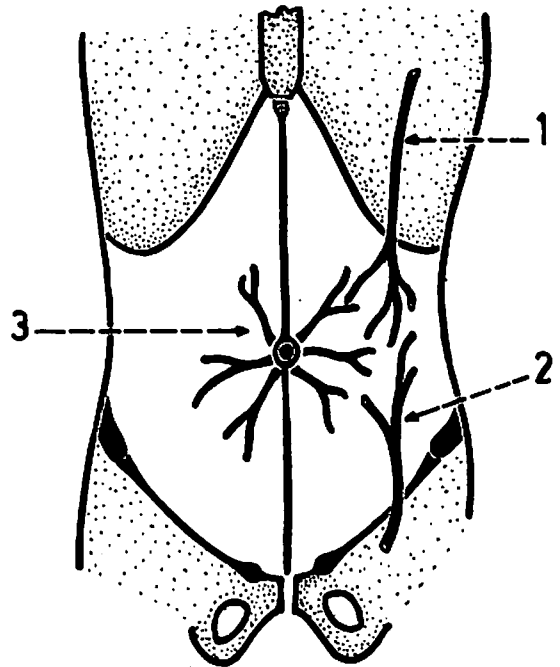


Fig.(53): LYMPHATIC DRAINAGE OF THE SKIN AND SUPERFICIAL FASCIA OF THE ANTEROLATERAL ABDOMINAL WALL

The skin and superficial fascia of the anterior abdominal wall are drained by superficial lymphatic vessels. The region above the umbilicus is drained into the pectoral group of axillary lymph nodes, while the region below the umbilicus drains into the superficial inguinal lymph nodes.

1. pectoral lymph nodes.
2. level of the umbilicus.
3. superficial inguinal lymph nodes.

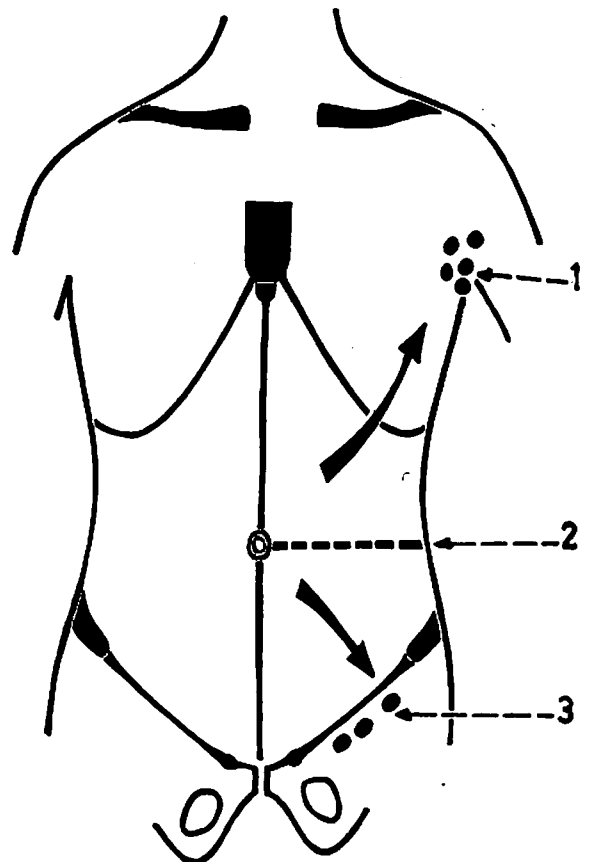


Fig.(54): LYMPHATIC DRAINAGE OF DEEP LAYERS OF THE ANTEROLATERAL ABDOMINAL WALL

The deep layers of the anterolateral abdominal wall including the lining parietal peritoneum are drained by deep lymphatic vessels. The region above the umbilicus is drained into the parasternal lymph nodes situated along the internal thoracic artery while the region below the umbilicus is drained into the external iliac nodes along the external iliac vessels.

1. parasternal lymph nodes.
2. level of the umbilicus.
3. external iliac lymph nodes.

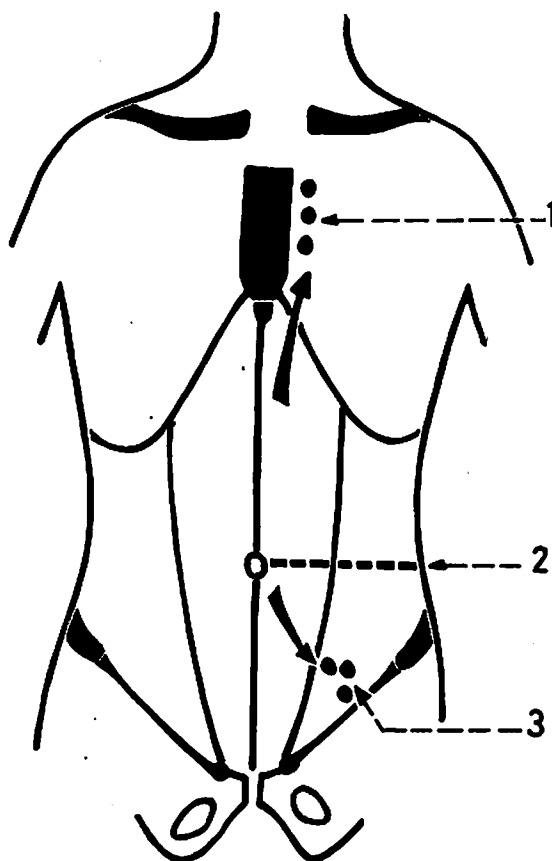
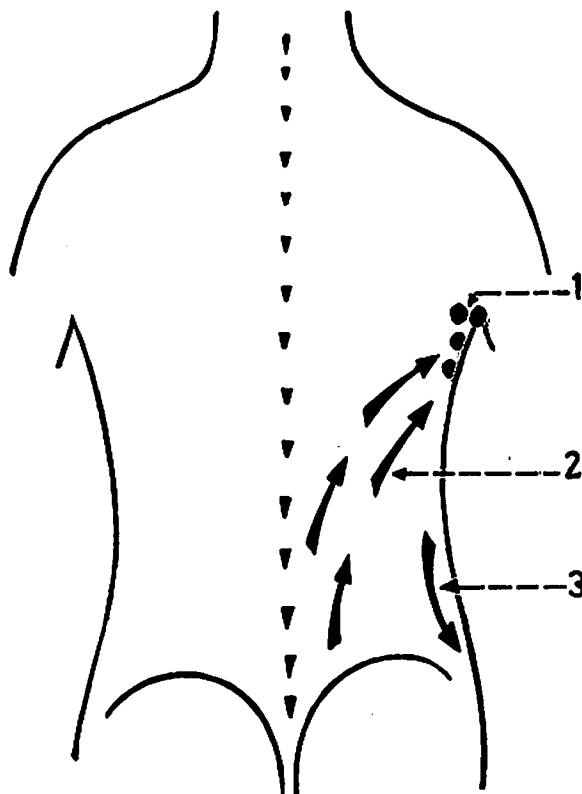


Fig.(55): LYMPH DRAINAGE OF THE SUPERFICIAL LAYERS OF THE BACK AND THE LOIN

The back down to the iliac crest is drained into the subscapular group of axillary lymph nodes, while the loin is drained into the superficial inguinal lymph nodes.

1. subscapular lymph nodes.
2. region of the back.
3. region of the loin.

* Note that the posterior abdominal wall is drained by deep lymphatic vessels into the lateral aortic lymph nodes.



NERVE SUPPLY OF THE ANTEROLATERAL WALL OF THE ABDOMEN

Fig.(56): NERVES OF THE ANTEROLATERAL ABDOMINAL WALL

The skin and muscles of the anterolateral abdominal wall are supplied by the lower 5 intercostal nerves, subcostal nerve, ilio-hypogastric nerve and ilio-inguinal nerve. These nerves belong to the lower 6 thoracic and 1st lumbar nerves. These nerves (except the ilio-inguinal) end close to the midline as the anterior cutaneous nerves. In the mid-axillary line, these nerves (except the ilio-inguinal) give off lateral cutaneous branches. The 3 flat muscles and the rectus abdominis are supplied by the lower 5 intercostal and subcostal nerves with additional fibres from the 1st lumbar nerve to the internal oblique and transversus abdominis. The pyramidalis is supplied by the subcostal nerve only.

1. anterior cutaneous branches.
2. subcostal nerve (T.12).
3. ilio-hypogastric nerve (L.1).
4. ilio-inguinal nerve emerging from the superficial inguinal ring (L.1).
5. lateral cutaneous branches (in the midaxillary line).

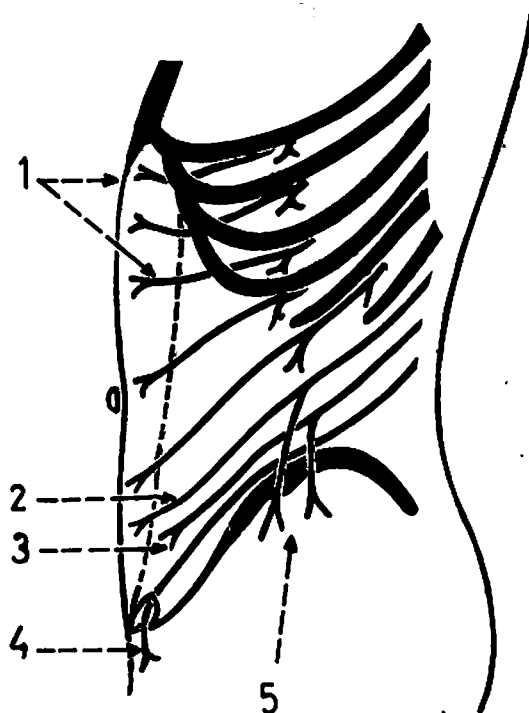


Fig.(57): DISTRIBUTION OF THE NERVES TO THE SKIN OF THE ANTERIOR ABDOMINAL WALL

1. the 7th intercostal nerve (T.7): supplies the skin just below the xiphoid process.
2. the 10th intercostal nerve (T.10): supplies the skin at the level of the umbilicus.
3. the subcostal nerve (T.12): supplies the skin of the supra-pubic region.
4. the ilio-hypogastric nerve (L.1): supplies the skin just above the inguinal ligament.
5. the ilio-inguinal nerve (L.1): supplies the skin of the external genital organs and upper part of the medial side of the thigh.

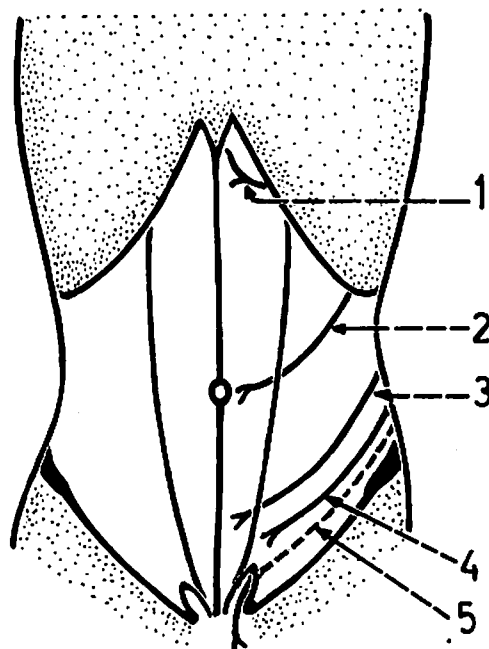


Fig.(58): COURSE OF THE NERVES WITHIN THE RECTUS SHEATH

The lower 5 intercostals and the sub-costal nerve enter the rectus sheath, pass medially through the rectus abdominis and leave the sheath through its anterior wall as the anterior cutaneous branches close to the midline. However, the ilio-hypogastric and ilio-inguinal nerves do not enter the rectus sheath.

1. nerves outside the rectus sheath.
2. nerves inside the rectus sheath.
3. anterior cutaneous branches.

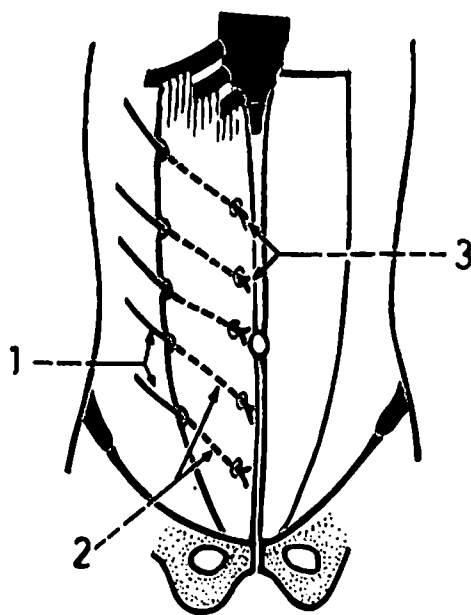


Fig.(59): COURSE OF THE SUBCOSTAL NERVE

The subcostal nerve (T.12) leaves the vertebral canal to lie in front of the quadratus lumborum. It then pierces the transversus abdominis at its origin from the thoraco-lumbar fascia to enter the neuro-vascular plane between the transversus abdominis and internal oblique. The nerve continues forwards in this plane to enter the rectus sheath by piercing the posterior lamella of the aponeurosis of the internal oblique. It penetrates the rectus abdominis then leaves the sheath as the anterior cutaneous branch.

1. anterior cutaneous branch (close to the midline).
2. lateral cutaneous branch (at the mid-axillary line).
3. quadratus lumborum surrounded by the thoraco-lumbar fascia.
4. the nerve in front of the quadratus lumborum.
5. the nerve in the neurovascular plane.
6. transversus abdominis.
7. the nerve piercing the posterior lamella of the internal oblique.
8. the nerve penetrating the rectus abdominis from lateral to medial.

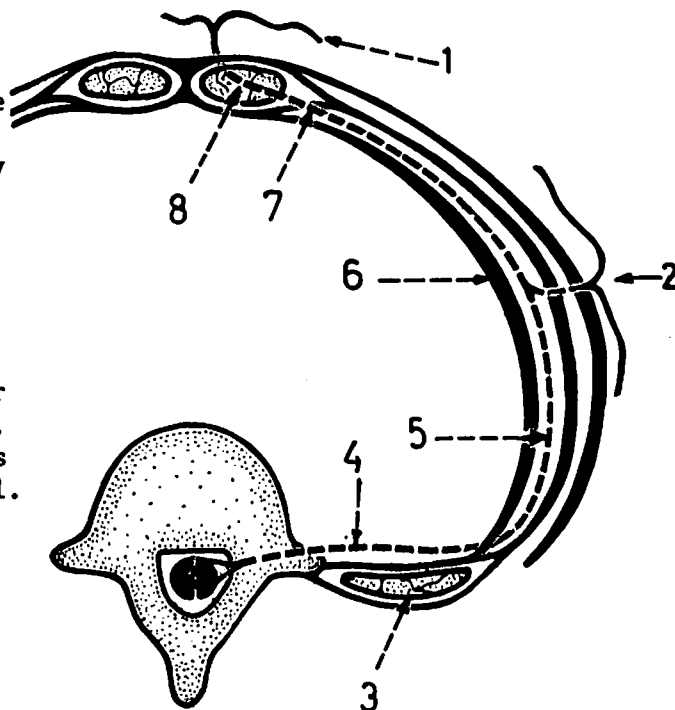


Fig.(60): SEGMENTAL INNERVATION OF THE SKIN OF THE FRONT OF THE TRUNK

1. area above the manubrio-sternal junction: supplied by the 4th cervical nerve.
2. area just below the manubrio-sternal junction: supplied by the 2nd thoracic nerve.
3. the area just below the xiphoid process: supplied by the 7th thoracic nerve.
4. the area at the level of the umbilicus: supplied by the 10th thoracic nerve.
5. the area just above the symphysis pubis: supplied by the 1st lumbar nerve.
6. the area of the skin of the external genital organs below the symphysis pubis: supplied by the 1st lumbar and 2nd sacral nerves.

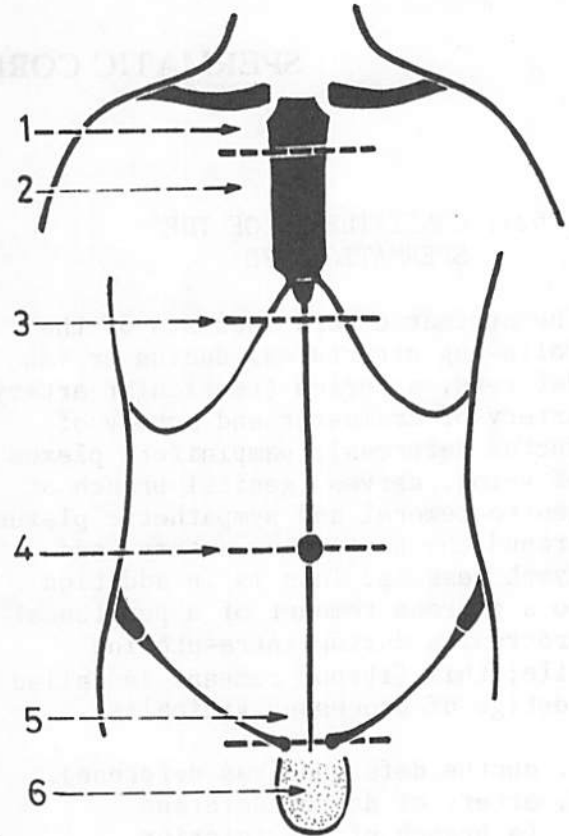
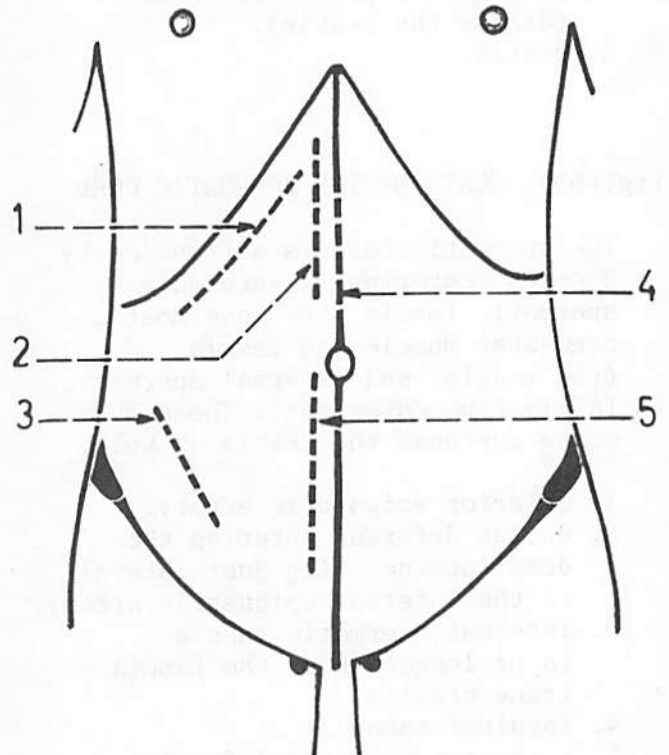


Fig.(61): ABDOMINAL INCISIONS

Abdominal incisions may be carried out exactly in the midline (midline incisions), parallel and close to the midline (para-median incisions) or far away from the midline (e.g. Kocher's incision and gridiron incision).

1. Kocher's incision.
2. upper para-median incision.
3. gridiron incision.
4. midline incision.
5. lower para-median incision.



SPERMATIC CORD AND SCROTUM

Fig.(62): CONSTITUENTS OF THE SPERMATIC CORD

The spermatic cord consists of the following structures: ductus or vas deferens, arteries (testicular artery, artery of cremaster and artery of ductus deferens), pampiniform plexus of veins, nerves (genital branch of genito-femoral and sympathetic plexus around the testicular artery) and lymph vessels. This is in addition to a fibrous remnant of a peritoneal protrusion during intra-uterine life; this fibrous remnant is called vestige of processus vaginalis.

1. ductus deferens (vas deferens).
2. artery of ductus deferens (a branch of the inferior vesical artery).
3. testicular artery (a branch of abdominal aorta).
4. pampiniform plexus of veins (drains the testis).
5. testis.

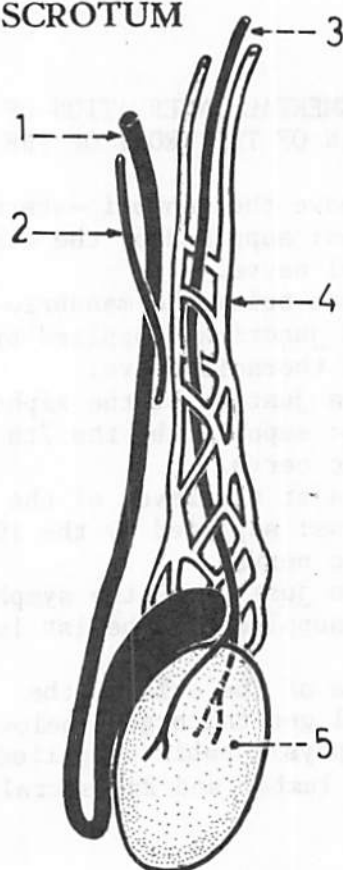


Fig.(63): COATS OF THE SPERMATIC CORD

The spermatic cord is surrounded by 3 coats (coverings): internal spermatic fascia (the innermost), cremaster muscle and fascia (the middle) and external spermatic fascia (the outermost). These 3 coats surround the testis as well.

1. inferior epigastric artery.
2. ductus deferens entering the deep inguinal ring just lateral to the inferior epigastric artery.
3. internal spermatic fascia (a prolongation of the fascia transversalis).
4. inguinal canal.
5. cremaster muscle and fascia.
6. external spermatic fascia (prolongation from the superficial inguinal ring).
7. skin of the scrotum.
8. testis and epididymis.

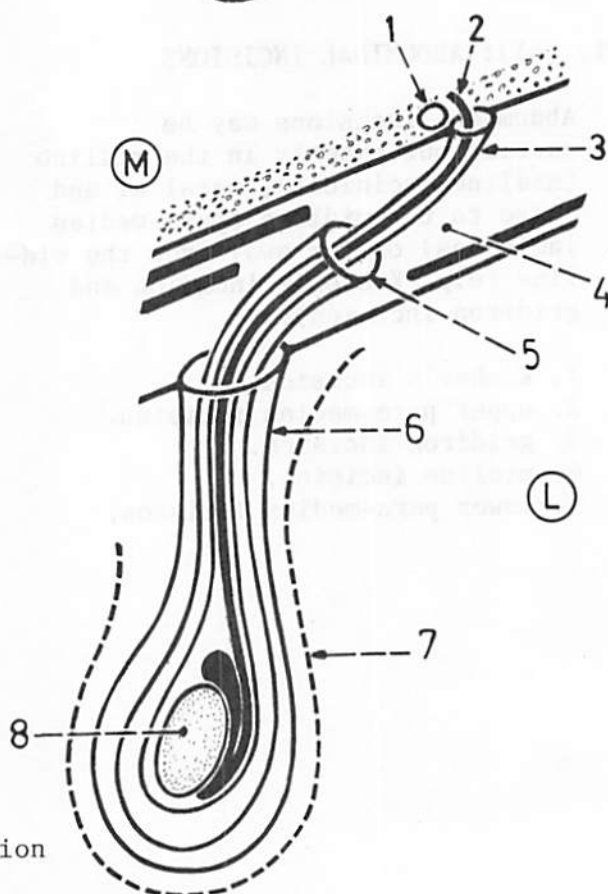
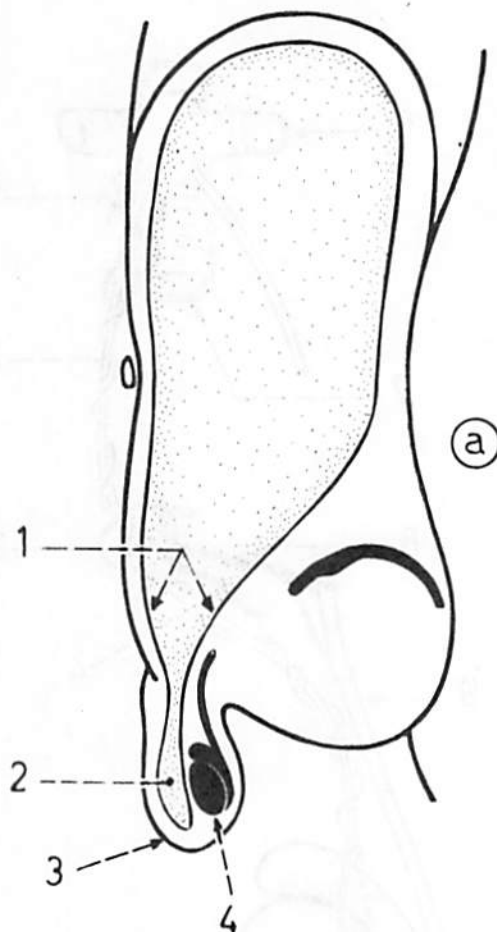


Fig.(64): PROCESSUS VAGINALIS
AND ITS VESTIGE

The processus vaginalis is a tubular prolongation of the peritoneal cavity which enters the scrotum during intra-uterine life. After birth, its distal part surrounds the testis to form the tunica vaginalis, while its proximal part is obliterated and becomes transformed into a fibrous band called vestige of processus vaginalis.

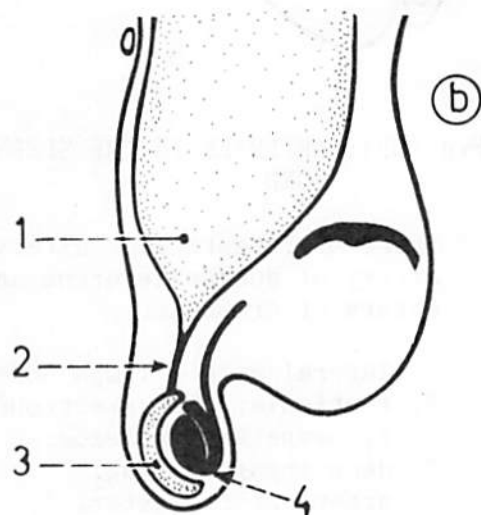
(a) Processus vaginalis before birth:

1. parietal peritoneum.
2. processus vaginalis (continuous with the peritoneal cavity).
3. scrotum.
4. testis.



(b) Vestige of processus vaginalis after birth:

1. peritoneal cavity.
2. vestige of processus vaginalis (fibrous band).
3. tunica vaginalis.
4. testis.



* The processus vaginalis may fail to become obliterated leading to the formation of congenital hydrocele.

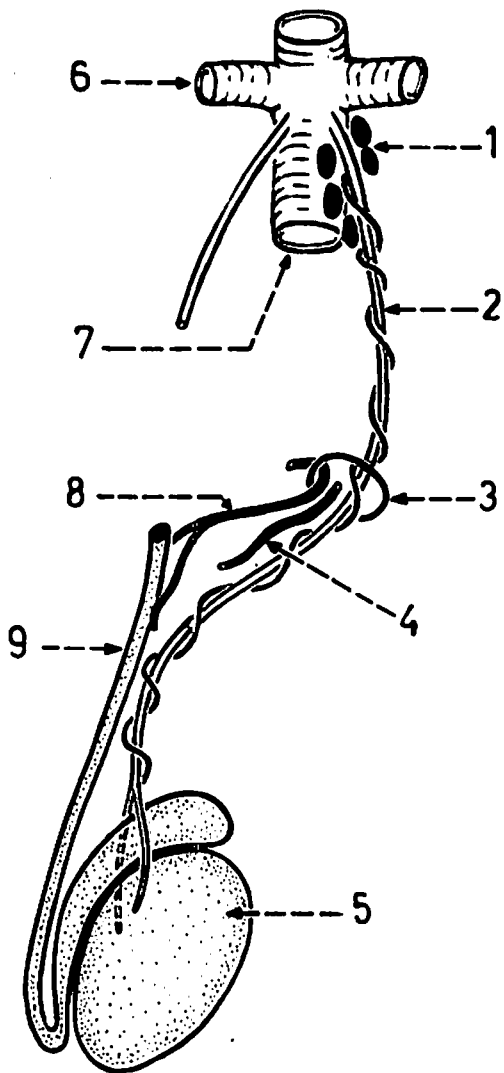


Fig.(65): ARTERIES IN THE SPERMATIC CORD

These are: testicular artery, artery of ductus deferens and artery of cremaster.

1. lateral aortic lymph nodes.
2. testicular artery surrounded by sympathetic plexus.
3. deep inguinal ring.
4. artery of cremaster.
5. testis.
6. renal artery.
7. abdominal aorta.
8. artery of ductus deferens.
9. ductus deferens.

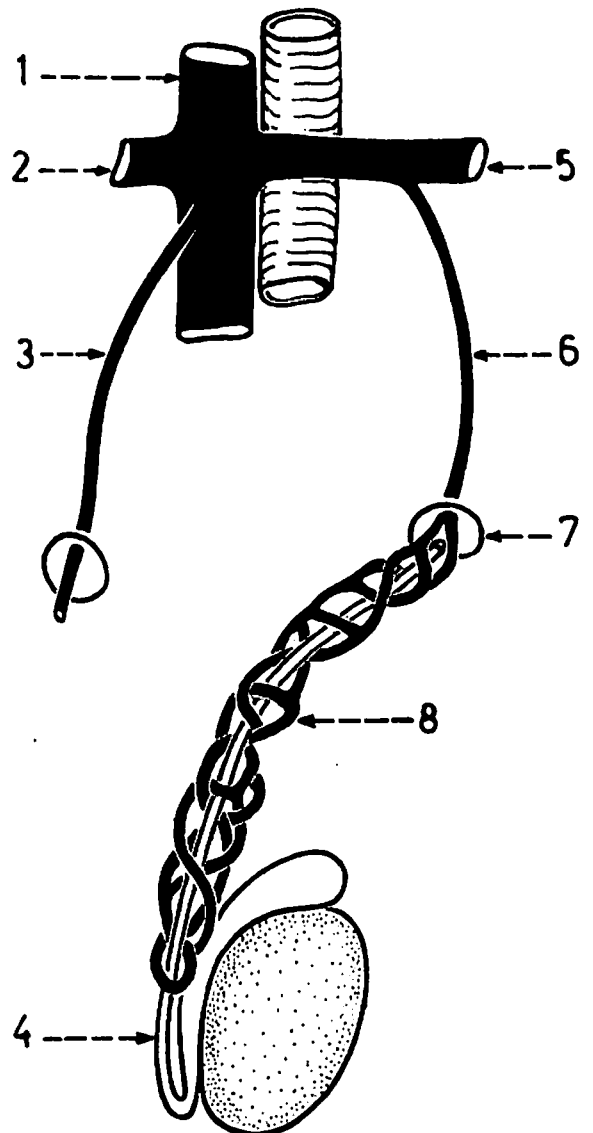


Fig.(66): PAMPINIFORM PLEXUS OF VEINS

This plexus surrounds the ductus deferens in the scrotum and inguinal canal. It ends at the deep inguinal ring by forming the testicular vein.

1. inferior vena cava.
2. right renal vein.
3. right testicular vein (ends in the inferior vena cava).
4. ductus deferens.
5. left renal vein.
6. left testicular vein (ends in the left renal vein).
7. deep inguinal ring.
8. pampiniform plexus of veins.

Fig.(67): WALL OF THE SCROTUM

It consists of skin, dartos muscle and the 3 coats of the spermatic cord.

1. dartos muscle (unstriated).
2. compartment of the scrotum.
3. median septum (an extension from the dartos muscle).
4. internal spermatic fascia.
5. cremaster muscle and fascia.
6. external spermatic fascia.
7. testis.

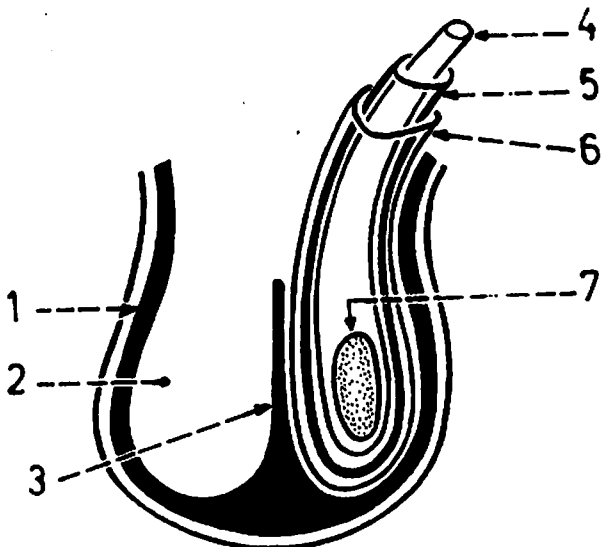


Fig.(68): ARTERIES OF THE SCROTUM

These are branches from the 3 pudendal arteries.

1. superficial external pudendal (from femoral).
2. deep external pudendal (from femoral).
3. scrotal branches of the perineal artery which is a branch of the internal pudendal.

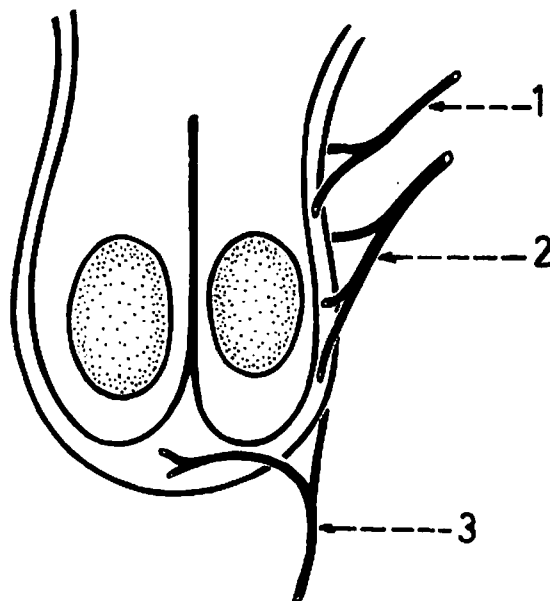


Fig.(69): NERVE SUPPLY AND LYMPH DRAINAGE OF THE SCROTUM

The skin of the scrotum is supplied by branches from: ilio-inguinal nerve, perineal nerve and posterior cutaneous nerve of the thigh. The dartos muscle is involuntary and is supplied by sympathetic fibres.

The wall of the scrotum is drained into the superficial inguinal nodes (b), but the testis is drained into the lateral aortic nodes (a).

1. ilio-inguinal nerve (L.1).
2. perineal branch of posterior cutaneous nerve of thigh (S.2,3).
3. scrotal branches of the perineal nerve (S.2,3).

(a) drainage to lateral aortic nodes.

(b) drainage to superficial inguinal nodes.

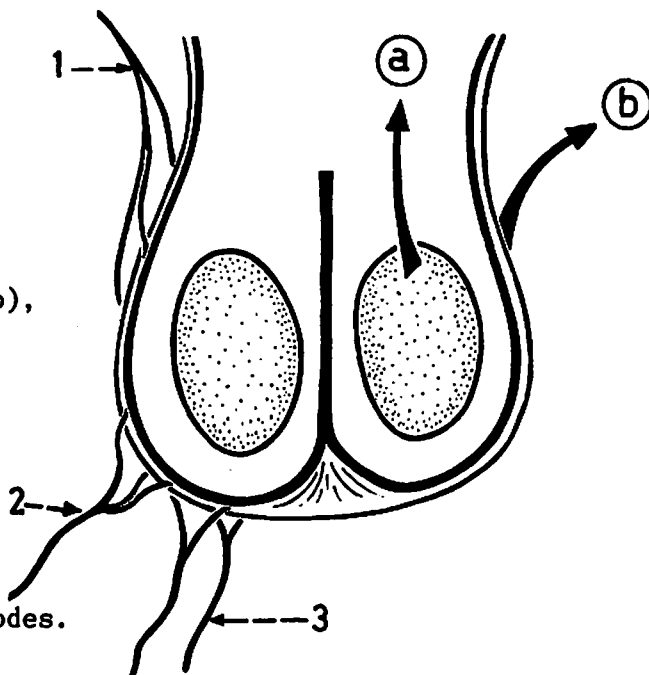


Fig.(70): STRUCTURE OF THE TESTIS
(horizontal section)

The testis is surrounded by the tunica vaginalis except on its posterior border where the epididymis and ductus deferens lie. The tunica vaginalis has a visceral layer, a parietal layer and a cavity in between. The testis has a thick fibrous wall called tunica albuginea which sends a number of septa inside the testis dividing it into compartments called lobules of the testis. Each compartment contains 2-3 seminiferous tubules.

1. tunica albuginea.
2. compartment (lobule) of testis.
3. parietal layer of tunica vaginalis.
4. cavity of tunica vaginalis.
5. visceral layer of tunica vaginalis.
6. septum from tunica albuginea.
7. sinus of epididymis (directed laterally).
8. epididymis on posterior border of testis.
9. testicular artery.
10. ductus deferens.
11. mediastinum testis (thickened posterior part of tunica albuginea lodging the rete testis).

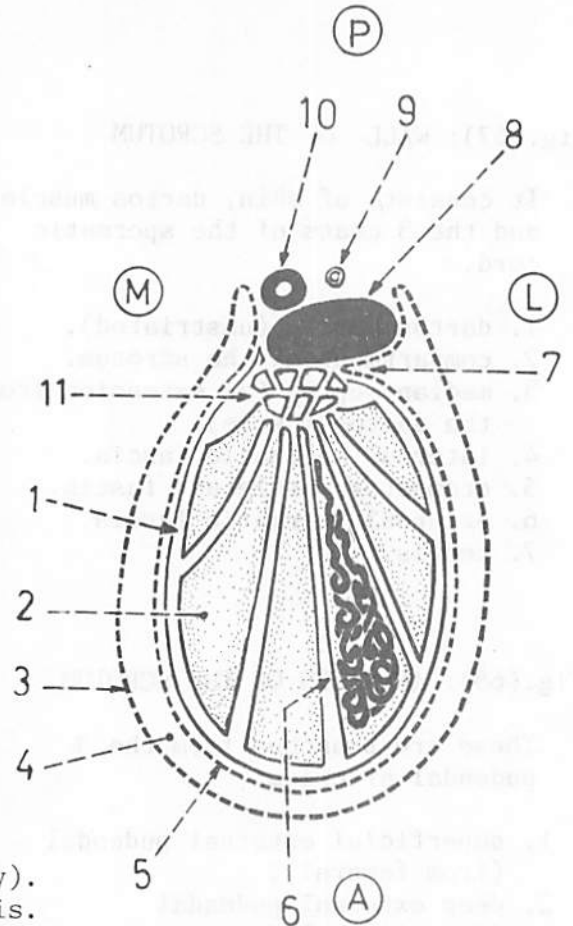


Fig.(71): STRUCTURE OF TESTIS AND
EPIDIDYMIS
(longitudinal section)

1. appendix of epididymis: an appendage attached to the head of epididymis.
2. lobule of epididymis.
3. parietal layer of tunica vaginalis.
4. appendix of testis: oval body attached to upper end of testis.
5. visceral layer of tunica vaginalis.
6. tunica albuginea.
7. tunica vasculosa.
8. head of epididymis.
9. ductus deferens.
10. body of epididymis.
11. tail of epididymis.

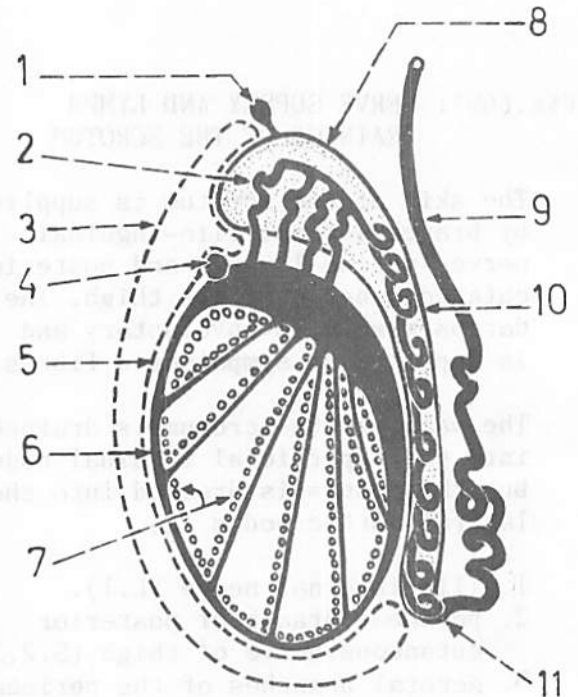
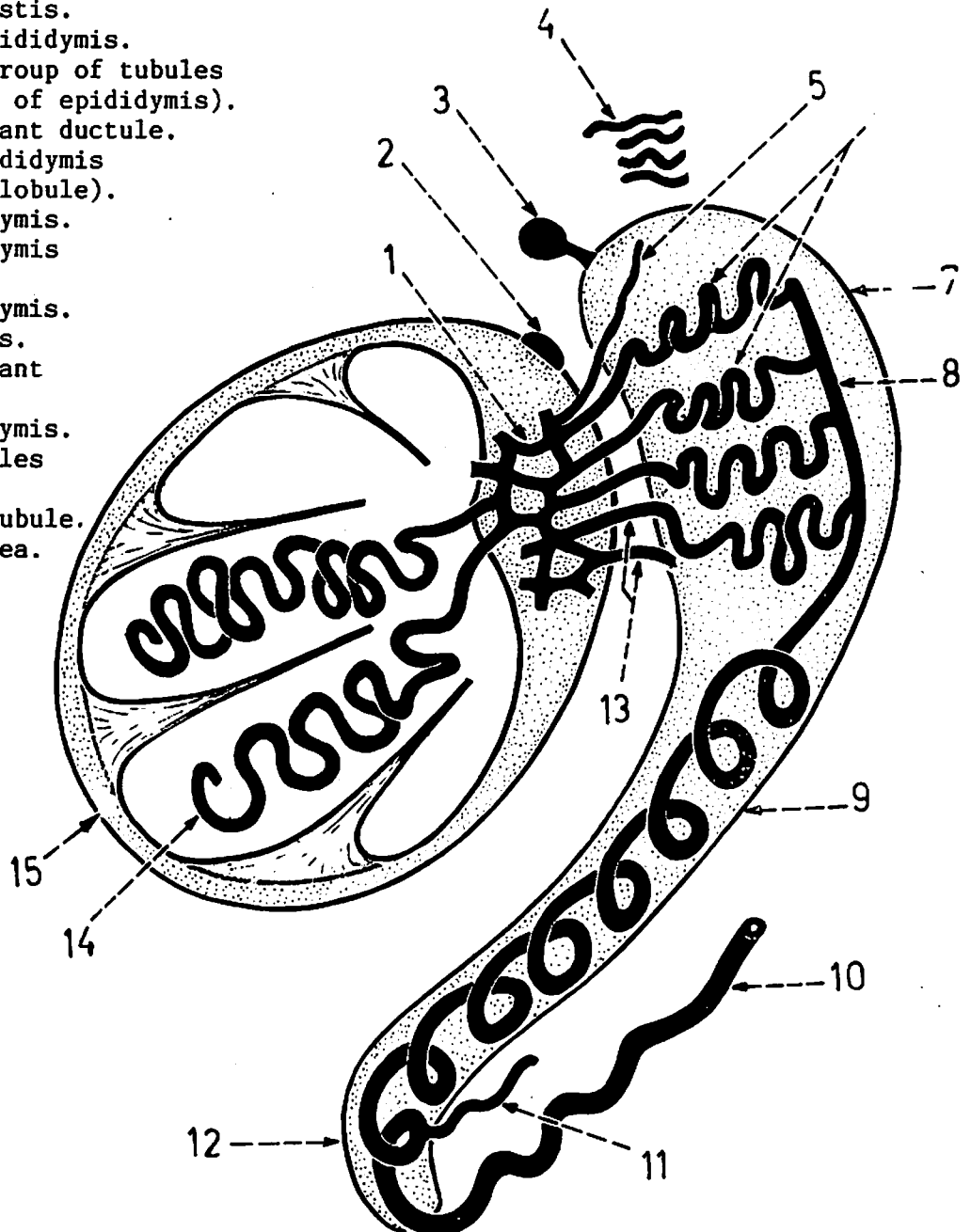


Fig.(72): DUCT SYSTEM OF TESTIS AND EPIDIDYMIS

The terminal open ends of the seminiferous tubules join together to form a network of tubules called the rete testis. This rete is present in the thickened posterior part of the tunica albuginea which is called mediastinum testis. Efferent ductules of the epididymis connect the rete testis with the tubules of the head of epididymis. These tubules of epididymis join the duct of epididymis. The duct of epididymis becomes highly convoluted to form the body and tail of epididymis. At the tail, the duct of epididymis becomes continuous with the ductus deferens.

1. rete testis situated in the mediastinum testis.
2. appendix of testis.
3. appendix of epididymis.
4. paradidymis (group of tubules above the head of epididymis).
5. superior aberrant ductule.
6. tubules of epididymis (each forms a lobule).
7. head of epididymis.
8. duct of epididymis (straight).
9. body of epididymis.
10. ductus deferens.
11. inferior aberrant ductule.
12. tail of epididymis.
13. efferent ductules of epididymis.
14. seminiferous tubule.
15. tunica albuginea.



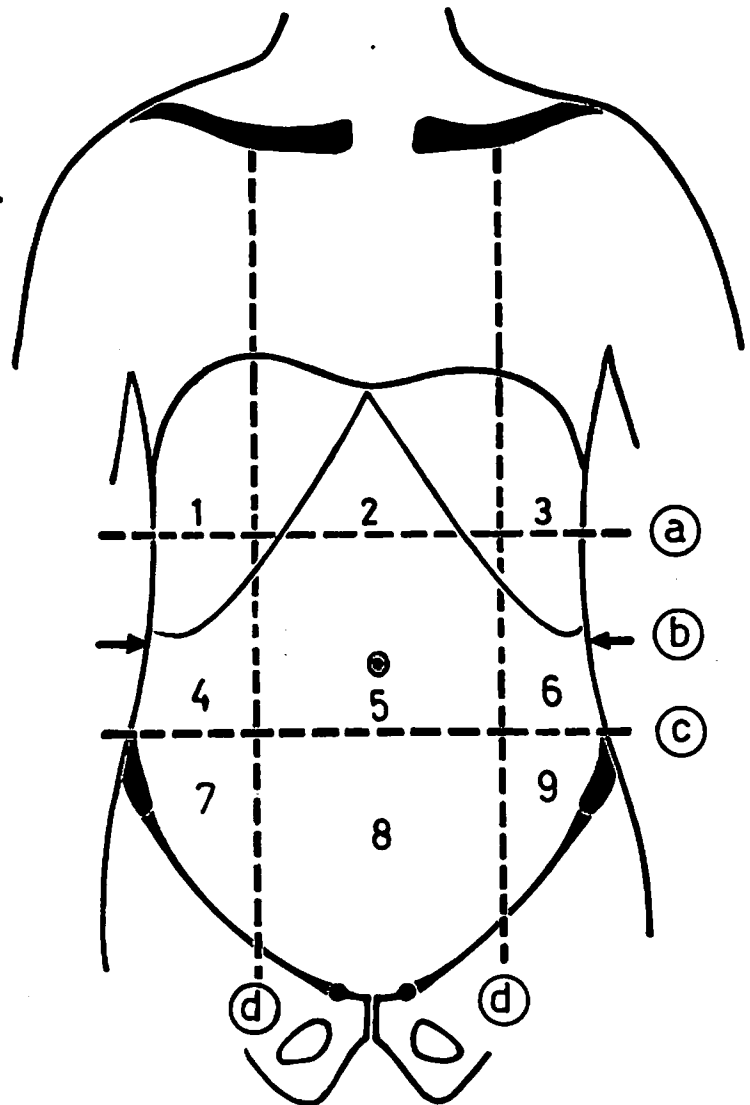
PERITONEUM

Fig.(73): REGIONS OF ABDOMINAL CAVITY

The abdominal cavity is divided into 9 regions by 2 horizontal planes and 2 vertical planes.

- (a) Transpyloric plane: a horizontal plane at the level of the 1st lumbar vertebra and the tip of the 9th costal cartilage.
- (b) Subcostal plane: a horizontal plane at the level of the 3rd lumbar vertebra and the 10th costochondral junction (this plane may be used instead of the transpyloric plane in description of the abdominal regions).
- (c) Transtubercular plane: a horizontal plane at the level of the tubercle of the iliac crest and the spine of the 5th lumbar vertebra.
- (d) Right and left lateral planes: these are 2 vertical planes each of which extends from the midclavicular point above to the midinguinal point below.

- 1. right hypochondriac region.
- 2. epigastric region.
- 3. left hypochondriac region.
- 4. right lumbar region.
- 5. umbilical region.
- 6. left lumbar region.
- 7. right iliac region.
- 8. hypogastric (pubic) region.
- 9. left iliac region.



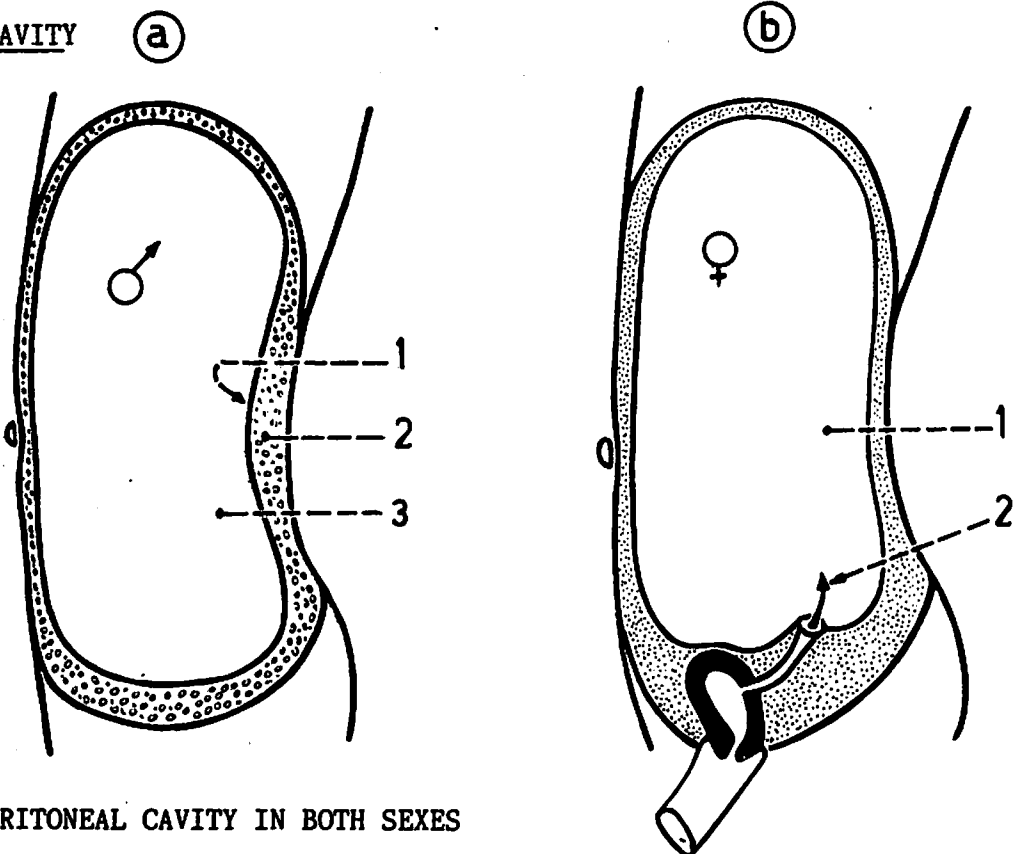
PERITONEAL CAVITY

Fig.(74): PERITONEAL CAVITY IN BOTH SEXES

The peritoneal cavity is a closed cavity in the male but in the female the uterine tubes open into it.

(a) In the male: 1. parietal peritoneum; 2. extraperitoneal tissue;
3. peritoneal cavity.

(b) In the female: 1. peritoneal cavity; 2. opening of uterine tube.

Fig.(75): PARIETAL AND VISCERAL LAYERS OF PERITONEUM (L.S.)

The peritoneum is a serous membrane. It lines the abdominal walls where it forms the parietal peritoneum, and is reflected on the viscera where it forms the visceral peritoneum.

1. peritoneal cavity.
2. parietal peritoneum.
3. visceral peritoneum surrounding a viscus.
4. peritoneal fold (between the parietal and visceral peritoneum).
5. retroperitoneal organ (outside the parietal peritoneum).

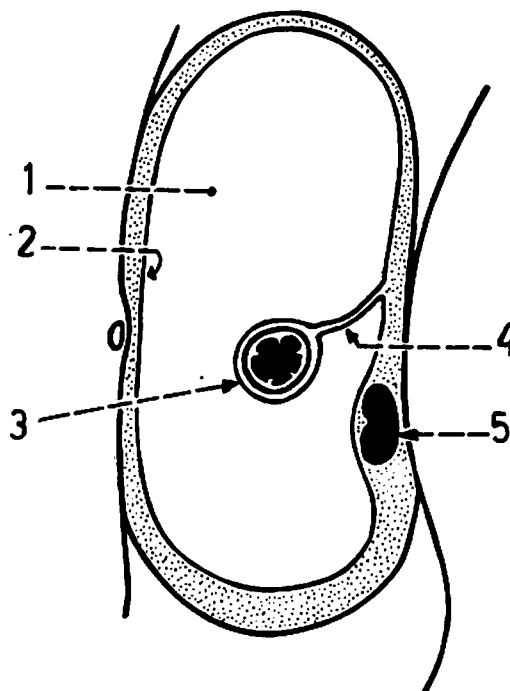


Fig.(76): GREATER SAC AND LESSER SAC OF PERITONEAL CAVITY

The greater sac forms most of the peritoneal cavity, while the lesser sac is a small cavity situated behind the stomach and lesser omentum.

1. opening leading to the lesser sac.
2. lesser omentum.
3. greater sac.
4. stomach.
5. lesser sac (omental bursa).

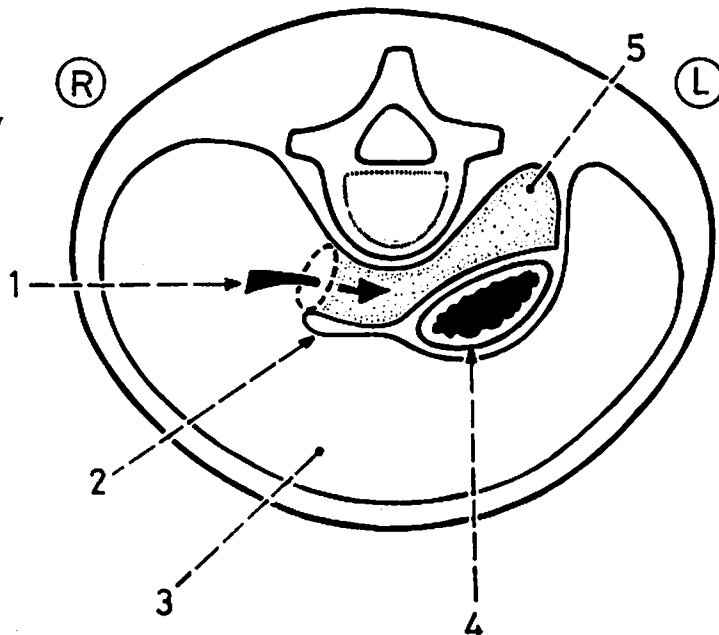
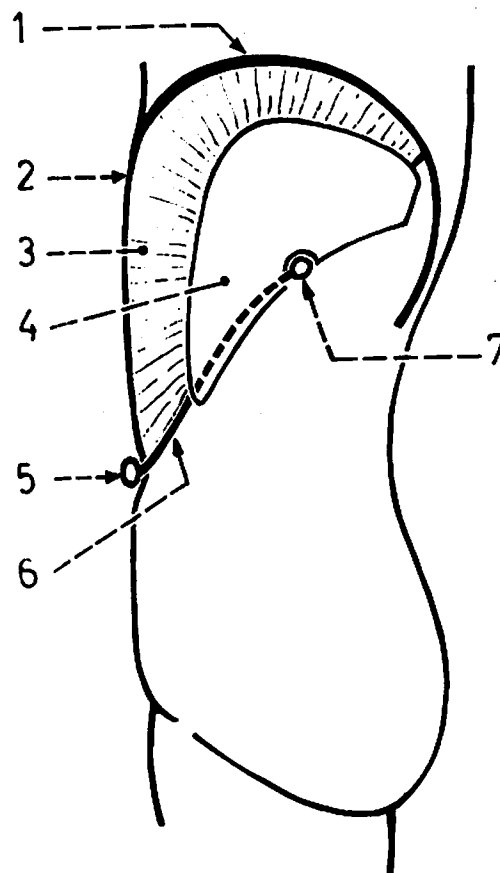


Fig.(77): FALCIFORM LIGAMENT

This ligament is a fold of peritoneum extending from the liver to the anterior abdominal wall as well as to the diaphragm. It divides the upper part of the greater sac into right and left compartments. It is formed of right and left layers. The peritoneum of the right layer extends over the right lobe of the liver while that of the left layer extends over the left lobe.

1. diaphragm.
2. anterior abdominal wall.
3. falciform ligament.
4. liver.
5. umbilicus.
6. ligamentum teres of the liver in the free lower border of the falciform ligament.
7. porta hepatis on the inferior surface of the liver.



* To understand the arrangement of the peritoneum of the upper part of the greater sac we should trace the extensions of the 2 layers of the falciform ligament over the liver.

Fig.(78): THE TWO LAYERS OF THE FALCIFORM LIGAMENT

The falciform ligament consists of right and left peritoneal layers and is attached to the anterior and upper surfaces of the liver at a line between the right and left lobes.

1. left lobe of liver.
2. left layer of falciform ligament.
3. ligamentum teres of the liver (between the 2 layers of the ligament at its free border).
4. free border of the falciform ligament.
5. right lobe of liver.
6. right layer of falciform ligament.

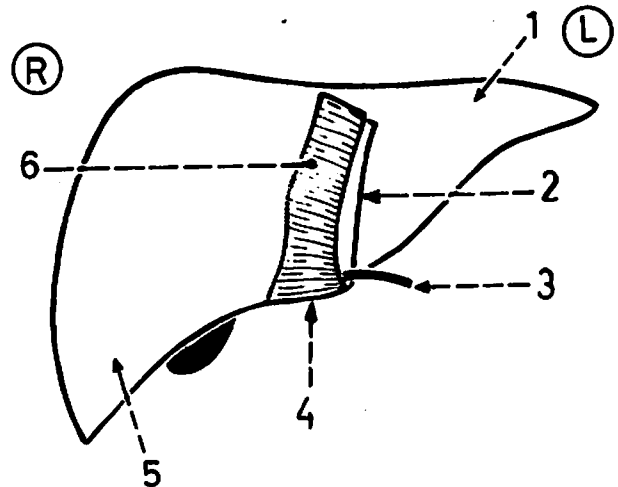


Fig.(79): EXTENSIONS OF THE TWO LAYERS OF THE FALCIFORM LIGAMENT OVER THE LIVER

1. the right layer of the falciform ligament passes to the right on the right lobe of the liver.
2. the right layer passes backwards over the right lobe and is reflected on the diaphragm to form the superior layer of coronary ligament.
3. the peritoneum passes to the right surface of the liver.
4. the peritoneum passes over the inferior surface of the liver and is reflected on the diaphragm to form the inferior layer of the coronary ligament.
5. the left layer of falciform ligament passes to the left on the left lobe of the liver.
6. the left layer passes backwards over the left lobe and is reflected on the diaphragm to form the superior layer of left triangular ligament.
7. the peritoneum passes over the inferior surface of the liver and is reflected on the diaphragm to form the inferior layer of the left triangular ligament.

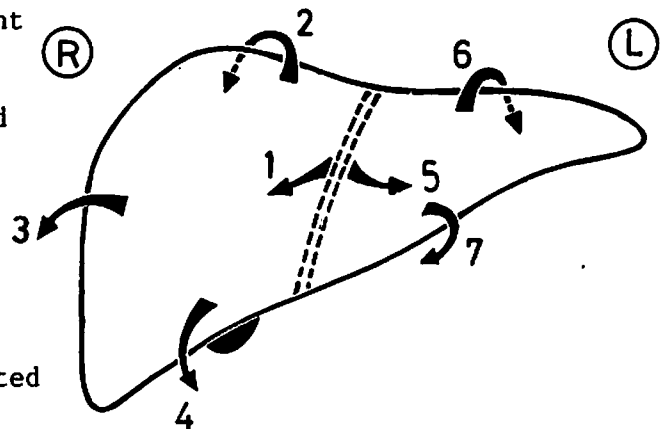


Fig.(80): REFLECTION OF PERITONEUM FROM THE RIGHT LOBE OF LIVER ON THE DIAPHRAGM

The reflection of peritoneum from the right lobe of the liver on the diaphragm behind forms the superior and inferior layers of the coronary ligament.

1. hepatorenal pouch (a part of the greater sac between the liver and the right kidney).
2. lower part of the greater sac.
3. part of the greater sac between the liver and diaphragm.
4. superior layer of coronary ligament.
5. bare area of liver (an area on the posterior surface of the right lobe of liver not covered by peritoneum and is bounded by the 2 layers of the coronary ligament).
6. inferior layer of coronary ligament.
7. right kidney.
8. right colic flexure.

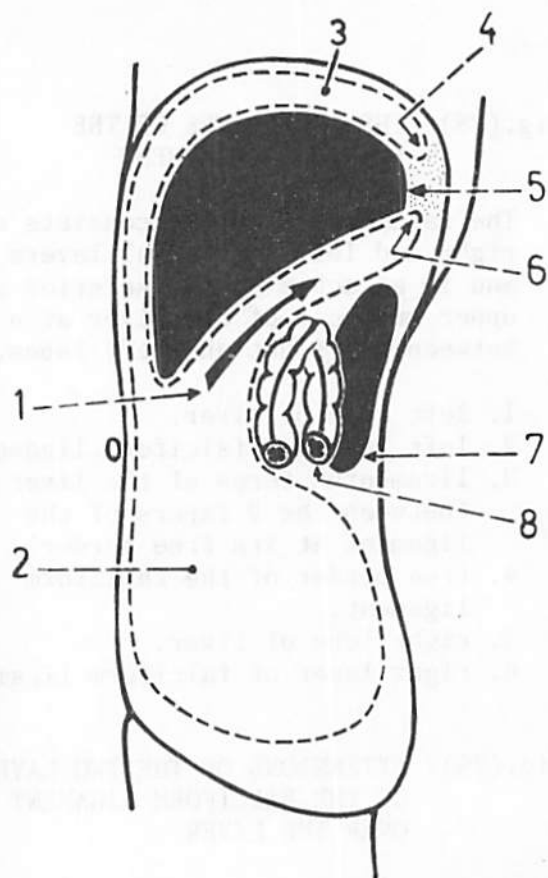
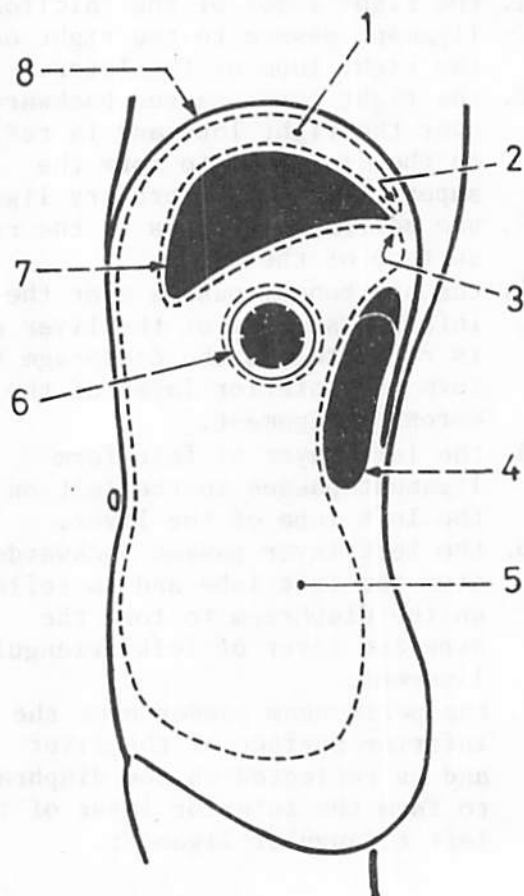


Fig.(81): REFLEXION OF PERITONEUM FROM THE LEFT LOBE OF LIVER ON THE DIAPHRAGM

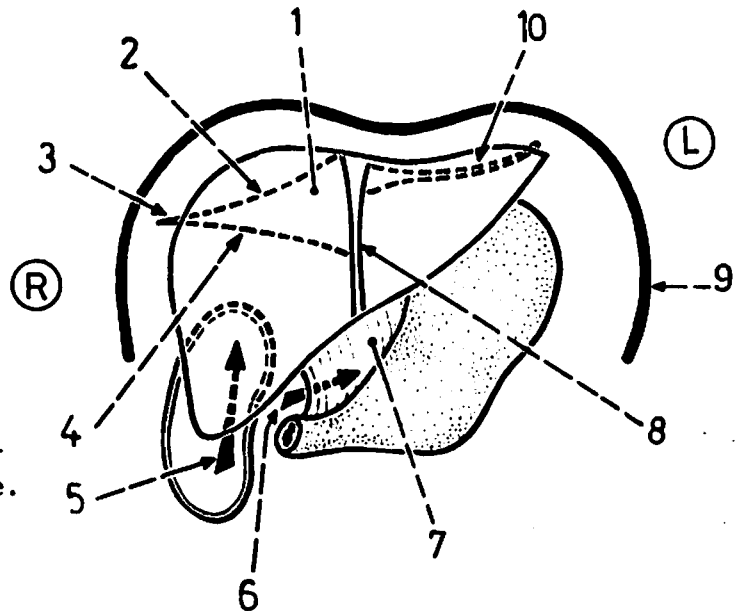
The reflexion of peritoneum from the posterior border of the left lobe of the liver on the diaphragm behind forms the superior and inferior layers of the left triangular ligament.

1. part of the greater sac between the left lobe of the liver and the diaphragm.
2. superior layer of left triangular ligament.
3. inferior layer of left triangular ligament.
4. left kidney.
5. lower part of greater sac.
6. stomach in the upper part of greater sac.
7. left lobe of liver.
8. diaphragm.



PERITONEAL FOLDS**Fig.(82): CORONARY AND TRIANGULAR LIGAMENTS**

The coronary and the 2 triangular ligaments connect the posterior aspect of the liver to the diaphragm behind. The coronary and right triangular ligaments are related to the right lobe of the liver, while the left triangular ligament is related to the left lobe. The right triangular ligament is the free right edge of the coronary ligament.

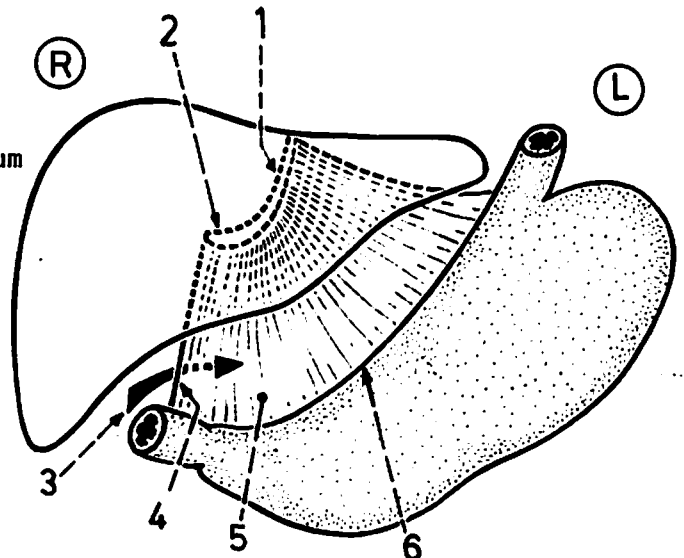


1. bare area of the liver.
2. superior layer of coronary ligament.
3. right triangular ligament.
4. inferior layer of coronary ligament.
5. hepatorenal pouch (between the right lobe of liver and right kidney).
6. arrow into the lesser sac.
7. lesser omentum.
8. line of attachment of the falciform ligament (between right and left lobes).
9. diaphragm.
10. left triangular ligament.

Fig.(83): LESSER OMENTUM

It is a peritoneal fold formed of 2 layers extending from the lesser curvature of the stomach and 1st inch of duodenum to the fissure for ligamentum venosum on the back of the liver and to the porta hepatis on its inferior surface.

1. fissure for ligamentum venosum.
2. site of porta hepatis.
3. arrow entering the lesser sac behind the lesser omentum.
4. free right border of lesser omentum.
5. lesser omentum.
6. lesser curvature of the stomach.



* The free right border of the lesser omentum forms the anterior boundary of the opening into lesser sac (epiploic foramen).

Fig.(84): ATTACHMENTS OF THE LESSER OMENTUM

The attachment of the lesser omentum to the liver is along an L-shaped line which corresponds to the fissure for ligamentum venosum and porta hepatis. Its attachment to the stomach and 1st inch of duodenum is also along an L-shaped line.

1. upper border of lesser omentum (reaches up to the diaphragm).
2. fissure for ligamentum venosum (vertical line).
3. cut surface of the liver to show the fissure for ligamentum venosum.
4. gall bladder on inferior surface of the liver.
5. porta hepatis (horizontal line).
6. arrow passing behind the free border of lesser omentum.
7. lesser omentum.

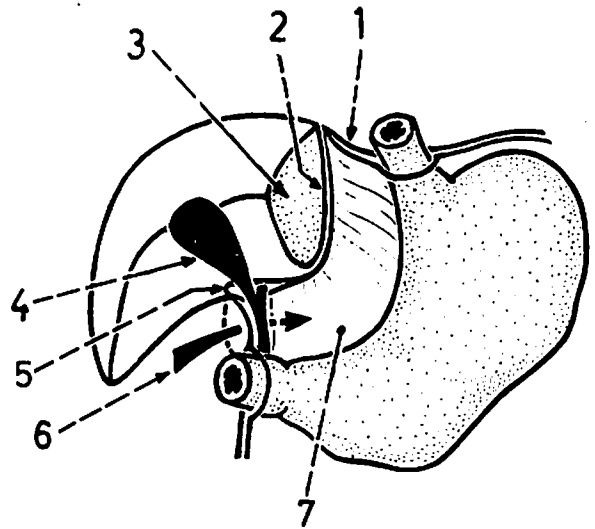


Fig.(85): CONTENTS OF LESSER OMENTUM

It contains mainly the following: left and right gastric vessels (along the lesser curvature of the stomach) and portal vein, bile duct and hepatic artery (in its free right border).

1. left gastric vessels.
2. lesser omentum.
3. portal vein, bile duct and hepatic artery in the free border.
4. free border of lesser omentum.
5. right gastric vessels.

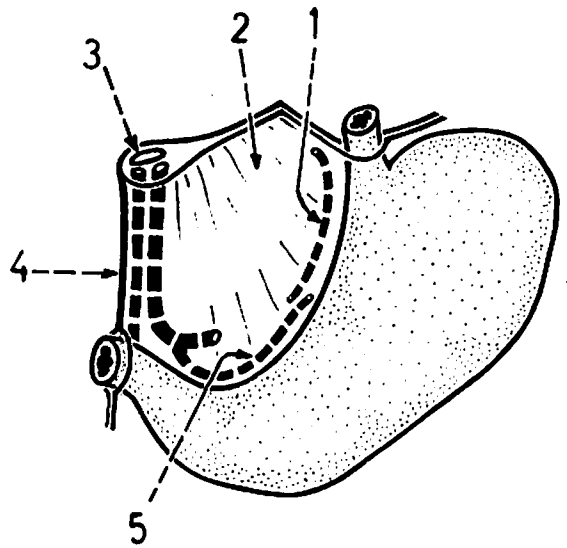


Fig.(86): STRUCTURES IN THE FREE BORDER OF LESSER OMENTUM

1. porta hepatis.
2. bile duct.
3. the 2 layers of the lesser omentum are continuous together forming its free border.
4. portal vein (behind the bile duct and the hepatic artery).
5. 1st part of duodenum.
6. hepatic artery.
7. lymph node.

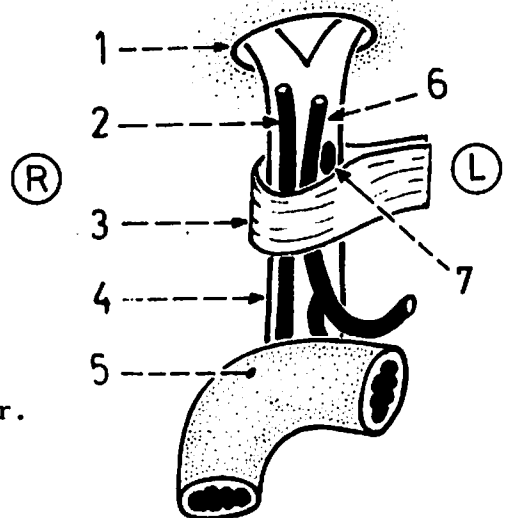
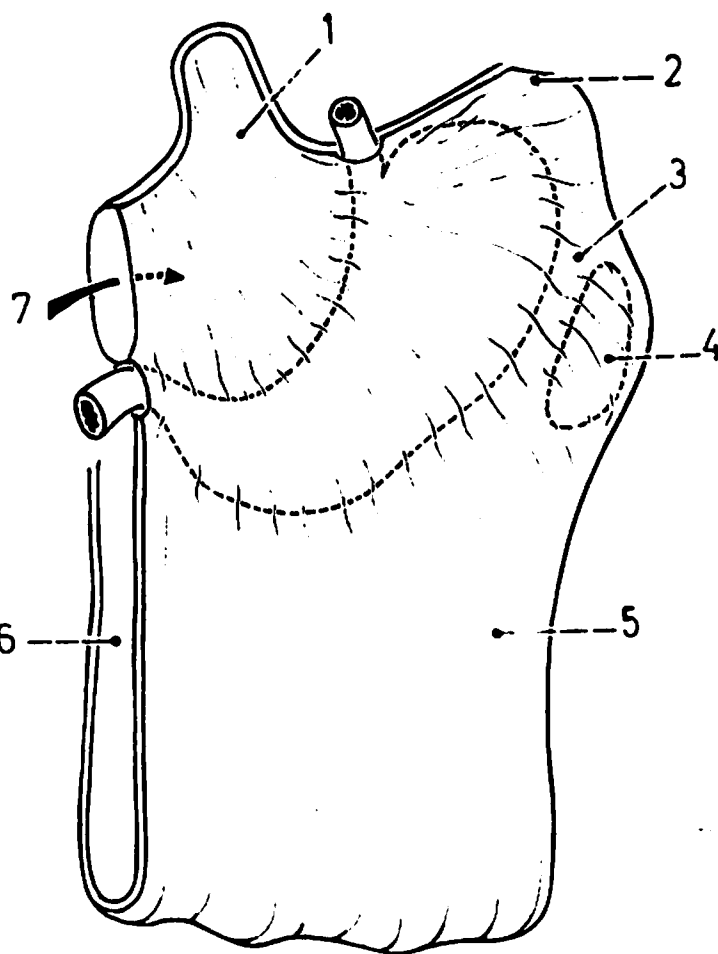


Fig.(87): LESSER OMENTUM AND GREATER OMENTUM

The lesser omentum is attached to the lesser curvature of the stomach while the greater omentum is attached to the lower part of the greater curvature of the stomach. The upper part of the greater curvature of the stomach gives attachment to the gastrophrenic and gastrosplenic ligaments.

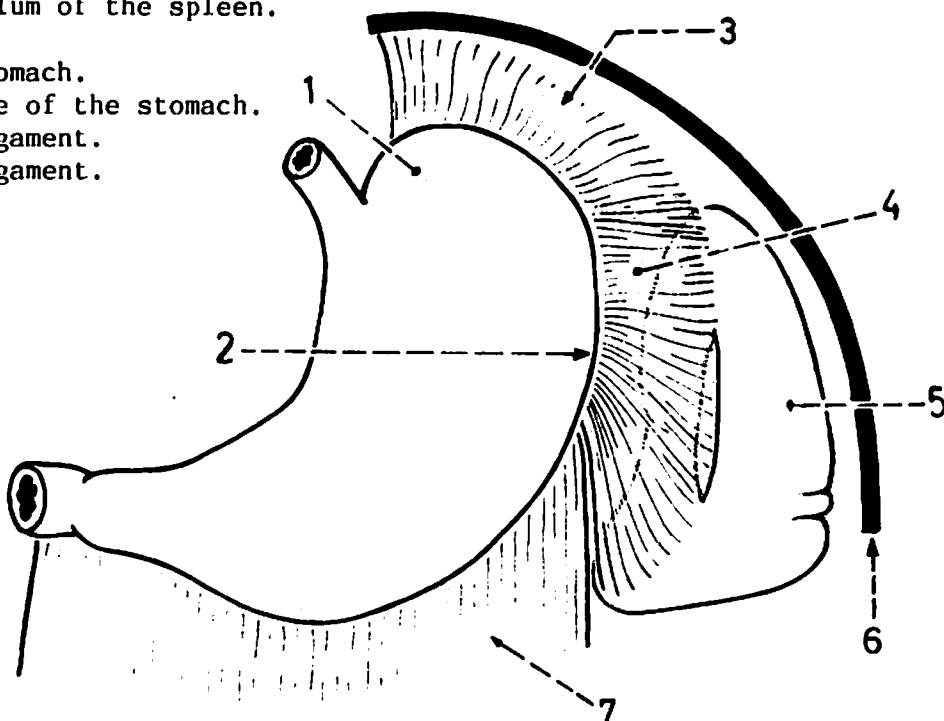


1. lesser omentum.
2. gastrophrenic ligament.
3. gastrosplenic ligament.
4. spleen.
5. greater omentum (formed of 4 layers of which 2 are anterior and 2 are posterior with a part of lesser sac in between).
6. part of the lesser sac between the layers of greater omentum.
7. arrow through the epiploic foramen.

Fig.(88): GASTROPHRENIC AND GASTROSPLenic LIGAMENTS

The gastrophrenic ligament extends from the uppermost part of the greater curvature of the stomach to the diaphragm, while the gastrosplenic ligament extends from the upper part of the greater curvature (below gastrophrenic ligament) to the hilum of the spleen.

1. fundus of the stomach.
2. greater curvature of the stomach.
3. gastrophrenic ligament.
4. gastrosplenic ligament.
5. spleen.
6. diaphragm.
7. greater omentum.



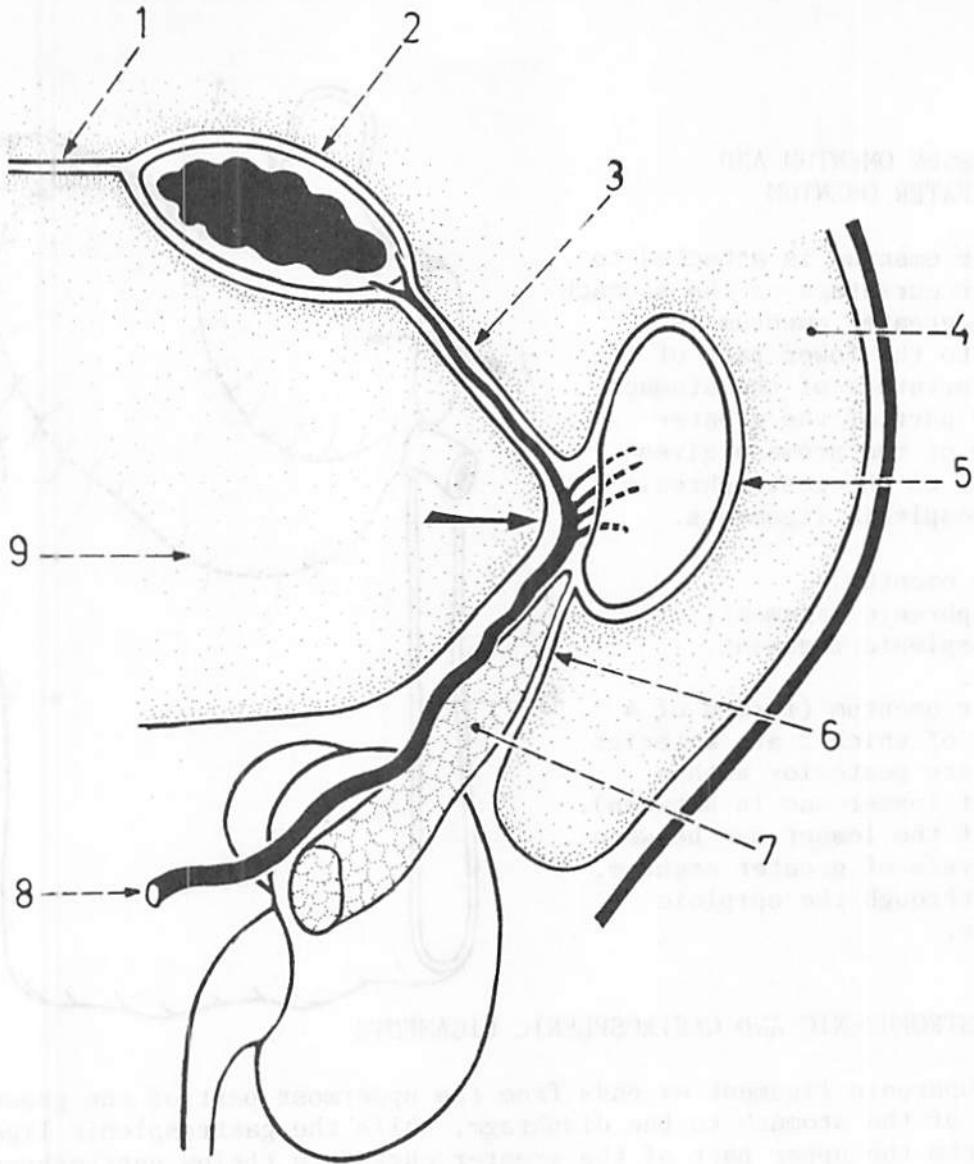


Fig.(89): GASTROSPLENIC AND LIENORENAL LIGAMENTS (coronal section)

The gastrosplenic ligament extends from the greater curvature of the stomach above the greater omentum to the hilum of the spleen; it contains short gastric vessels. The lienorenal ligament extends from the hilum of the spleen to the front of the left kidney; it contains the splenic vessels and tail of pancreas.

1. lesser omentum (attached to lesser curvature of the stomach).
2. stomach.
3. gastrosplenic ligament.
4. greater sac surrounding the spleen.
5. spleen completely covered by peritoneum.
6. lienorenal ligament.
7. tail of pancreas.
8. splenic artery.
9. lesser sac extending to the left as far as the hilum of the spleen.

Fig.(90): FOLLOW-UP OF THE PERITONEAL LAYERS FROM THE
GREATER OMENTUM TO THE POSTERIOR ABDOMINAL WALL
(sagittal section)

The greater omentum is formed of 4 layers of peritoneum (2 anterior and 2 posterior). The anterior 2 layers are attached above to the lower part of the greater curvature of the stomach and extend downwards for a variable distance then turn upwards to form the posterior 2 layers. These posterior 2 layers ascend behind the anterior 2 layers and in front of the transverse colon to reach the anterior border of the pancreas where they diverge. One of these 2 layers continues upwards on the posterior abdominal wall where it forms the posterior wall of lesser sac, while the other layer descends to enclose the transverse colon and returns to the pancreas thus forming the transverse mesocolon. This layer, then, descends on the posterior abdominal wall where it is reflected on the small intestine to form its mesentery and then continues downwards to the pelvis.

1. lesser omentum.
2. stomach.
3. lesser sac between the layers of the greater omentum.
4. anterior 2 layers of greater omentum.
5. lower limit of greater omentum.
6. lesser sac (behind the stomach and lesser omentum).
7. pancreas on the posterior abdominal wall.
8. fusion between the transverse mesocolon and posterior aspect of the greater omentum.
9. transverse mesocolon.
10. transverse colon (behind the greater omentum).
11. mesentery of small intestine.
12. small intestine.
13. posterior 2 layers of the greater omentum.

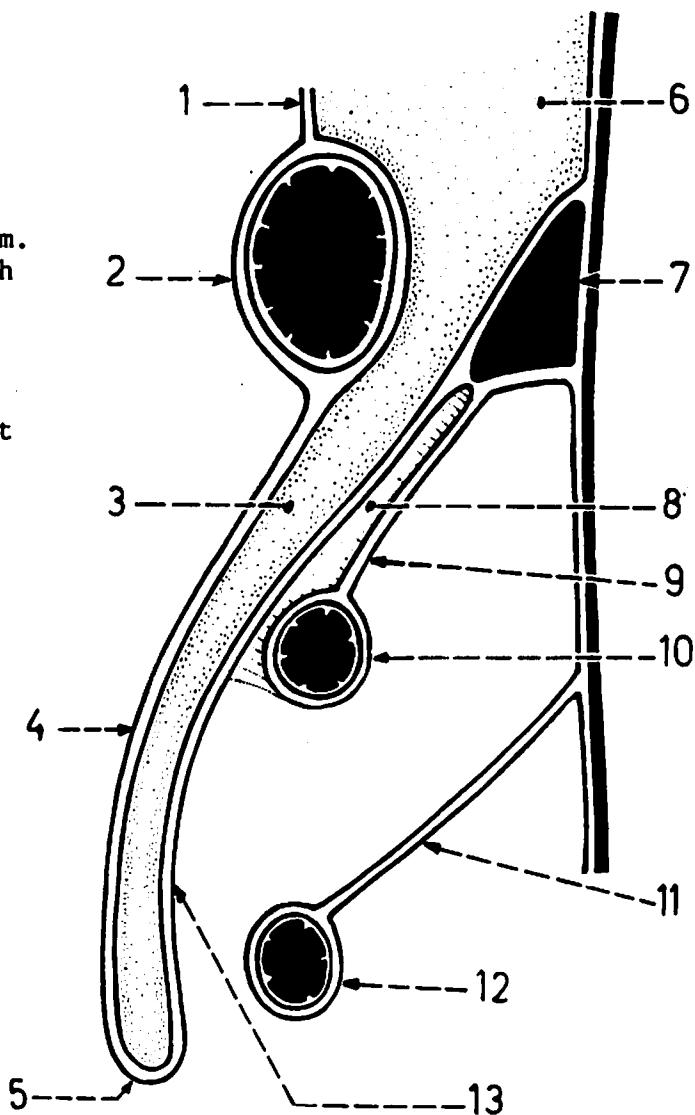


Fig.(91): ANOTHER DESCRIPTION OF FORMATION OF THE TRANSVERSE MESOCOLON

In fig.(90) the posterior 2 layers of the greater omentum are shown to ascend as far as the anterior border of the pancreas where they diverge, and the posterior one of these 2 layers is responsible for the formation of the transverse mesocolon. However, in another description (fig.91) the posterior 2 layers of the greater omentum surround the transverse colon and then continue upwards as far as the pancreas forming the transverse mesocolon.

1. stomach.
2. lesser sac between the layers of the greater omentum.
3. anterior 2 layers of the greater omentum.
4. pancreas(on the posterior abdominal wall).
5. transverse mesocolon
(formed by the continuation of the posterior 2 layers of the greater omentum).
6. transverse colon.
7. mesentery of small intestine.
8. posterior 2 layers of greater omentum.

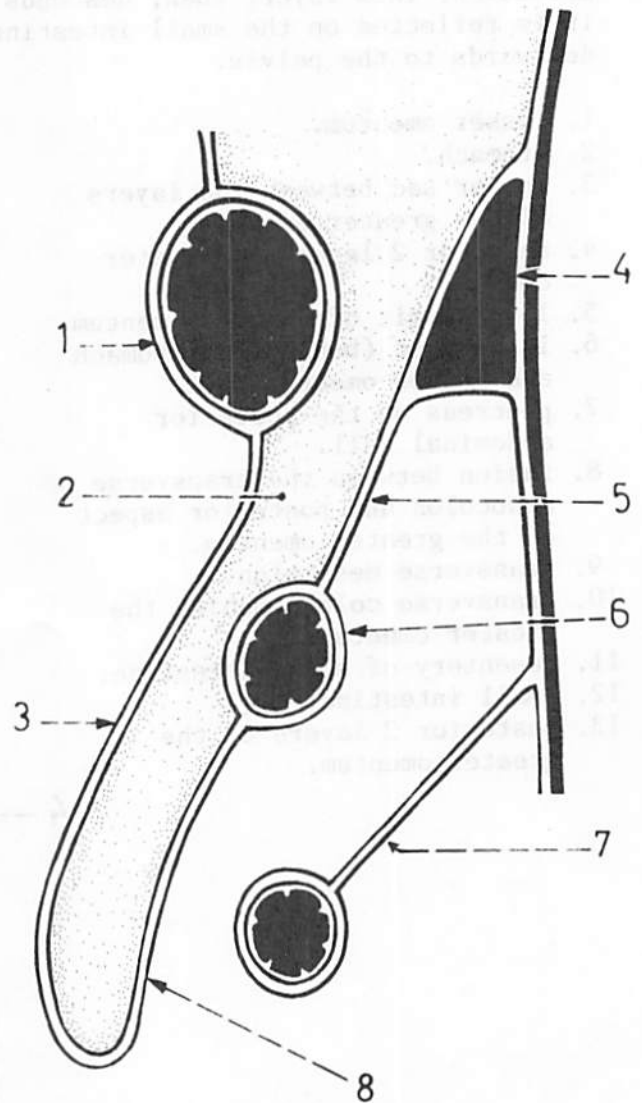


Fig.(92): MESENTERY OF THE SMALL INTESTINE

It is a fold of peritoneum formed of right and left layers which enclose the small intestine in its free border. Its attached border is attached to the posterior abdominal wall along a line which passes downwards and to the right from the duodeno-jejunal flexure to the ileo-caecal junction.

1. attached border of the mesentery of small intestine.
2. ileo-caecal junction.
3. part of the ileum surrounded by the mesentery.
4. duodeno-jejunal flexure.
5. free border of the mesentery (the intestine is removed).

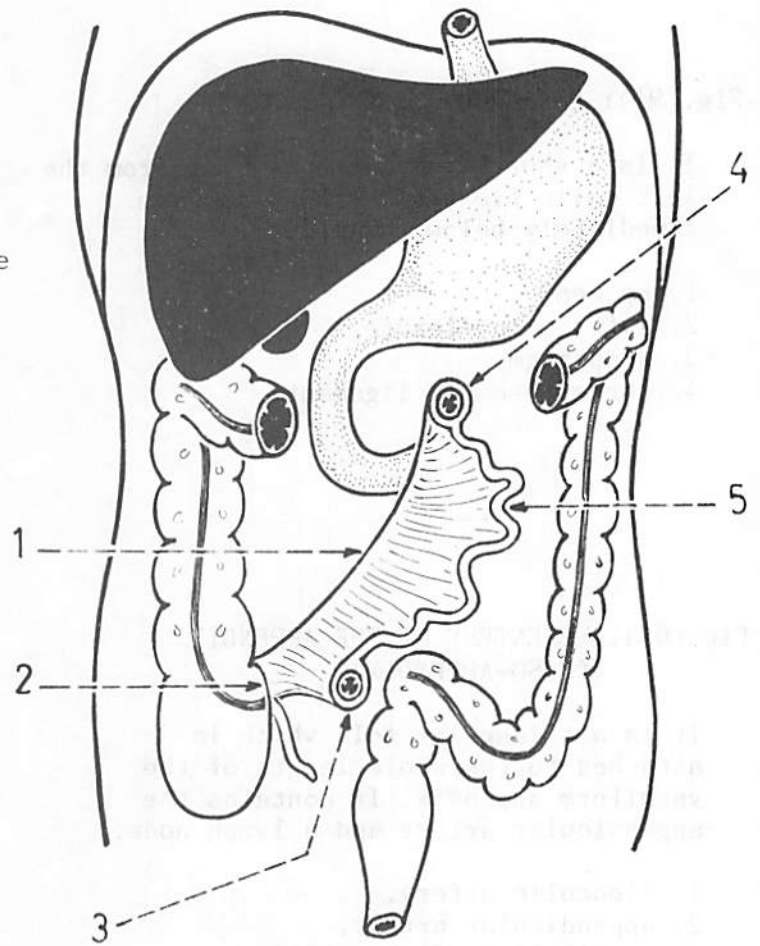


Fig.(93): FORMATION OF THE MESENTERY OF THE SMALL INTESTINE (T.S.)

The mesentery of the small intestine is formed of 2 layers (right and left). The right layer passes to the right to become continuous with the peritoneum of the posterior abdominal wall covering the ascending colon. The left layer passes to the left to become continuous with the peritoneum covering the descending colon.

1. greater sac.
2. small intestine.
3. parietal peritoneum.
4. left layer of the mesentery.
5. descending colon.
6. ascending colon.
7. right layer of the mesentery.

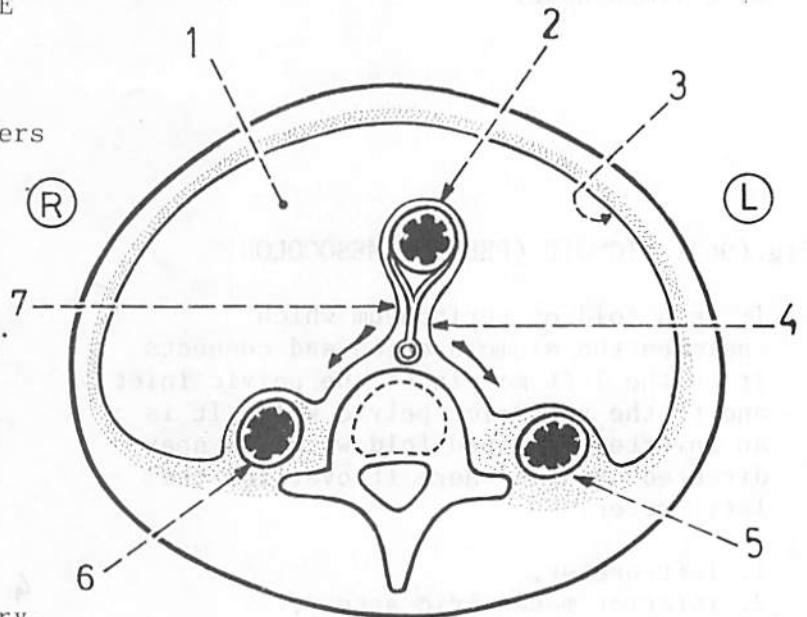


Fig.(94): PHRENICO-COLIC LIGAMENT

It is a short ligament extending from the left colic flexure to the diaphragm immediately below the spleen.

1. spleen.
2. left colic flexure.
3. diaphragm.
4. phrenico-colic ligament.

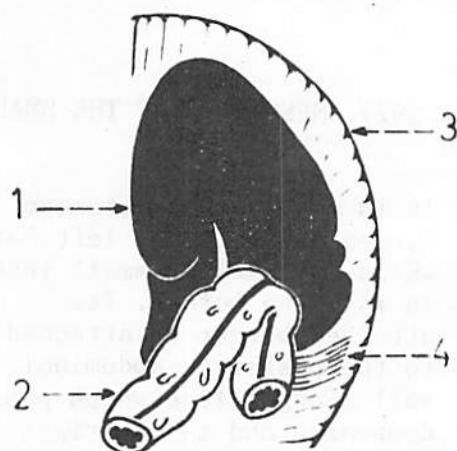


Fig.(95): MESENTERY OF THE APPENDIX (MESO-APPENDIX)

It is a triangular fold which is attached to the whole length of the vermiform appendix. It contains the appendicular artery and a lymph node.

1. ileocolic artery.
2. appendicular artery.
3. termination of the ileum.
4. meso-appendix.
5. vermiform appendix.
6. a lymph node.

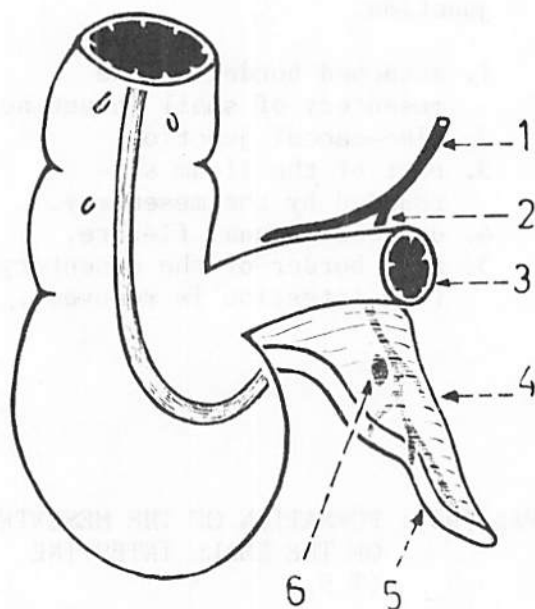
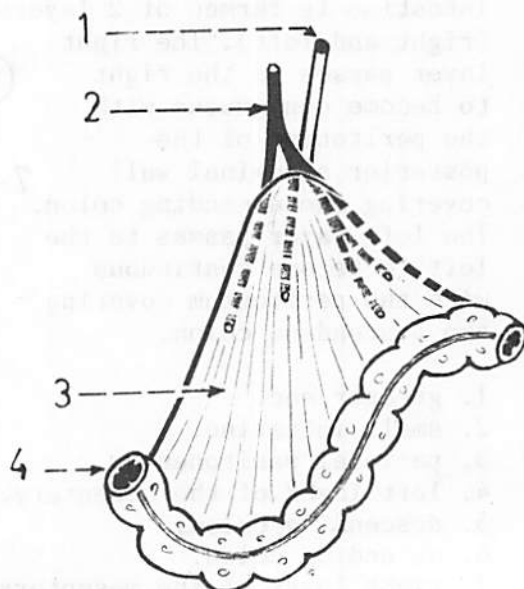


Fig.(96): SIGMOID (PELVIC) MESOCOLON

It is a fold of peritoneum which encloses the sigmoid colon and connects it to the left margin of the pelvic inlet and to the posterior pelvic wall. It is an inverted V-shaped fold with its apex directed upwards where it overlies the left ureter.

1. left ureter.
2. inferior mesenteric artery.
3. sigmoid mesocolon.
4. sigmoid colon.



LESSER SAC AND OTHER PERITONEAL RECESSES

Fig.(97): POSITION OF LESSER SAC
(sagittal section)

The lesser sac (omental bursa) is a peritoneal recess present behind the lesser omentum and stomach, and extends downwards into the greater omentum and upwards behind the caudate lobe of the liver. It communicates with the greater sac through the epiploic foramen.

1. stomach and lesser omentum.
2. greater sac of peritoneum.
3. lesser sac in greater omentum.
4. caudate lobe of the liver.
5. upward extension of lesser sac.
6. arrow in the epiploic foramen.
7. pancreas (behind the lesser sac).
8. transverse mesocolon.
9. part of the greater sac.

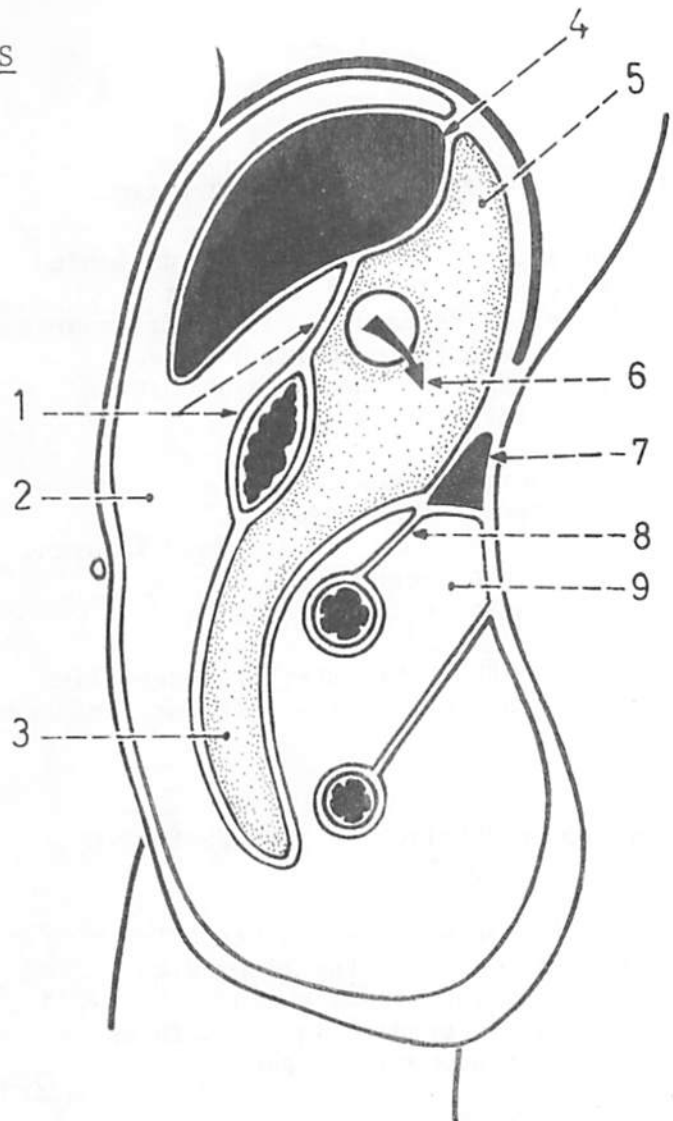
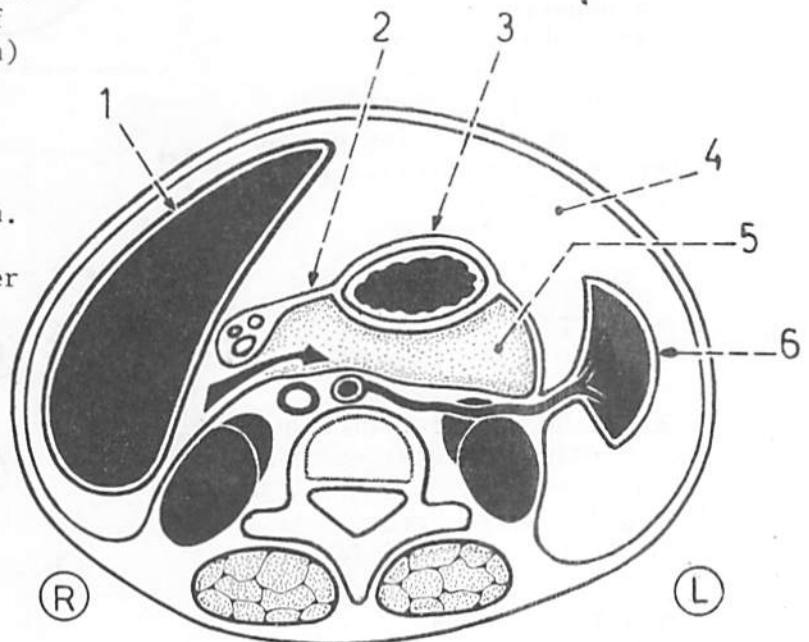


Fig.(98): POSITION OF LESSER SAC
(T.S. at the level of
the epiploic foramen)

The lesser sac is a closed recess which communicates with the greater sac only through the epiploic foramen. This foramen lies behind the free border of the lesser omentum.

1. liver.
2. lesser omentum.
3. stomach.
4. greater sac.
5. lesser sac.
6. spleen surrounded by the greater sac.



* The epiploic foramen is indicated by the arrow.

Fig.(99): OUTLINE OF THE LESSER SAC

The lesser sac extends upwards behind the caudate lobe of the liver (superior recess), to the left towards the spleen (splenic recess) and downwards into the greater omentum (inferior recess).

1. superior recess.
2. inferior vena cava.
3. arrow through the epiploic foramen.
4. splenic recess.
5. inferior recess.

* Note that the superior recess lies to the left of the inferior vena cava.

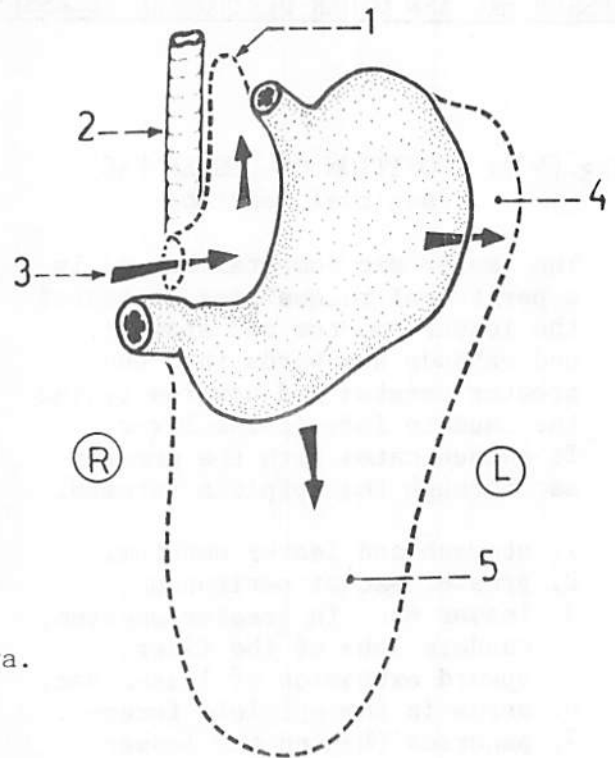


Fig.(100): RELATION OF THE LESSER SAC TO THE LIVER

The lesser sac lies mainly below the left lobe of the liver with its superior recess extending behind the caudate lobe. It forms the left subhepatic space.

1. porta hepatis.
2. caudate lobe of liver.
3. inferior vena cava.
4. arrow into epiploic foramen.
5. inferior recess of lesser sac.
6. superior recess of lesser sac.
7. splenic recess.

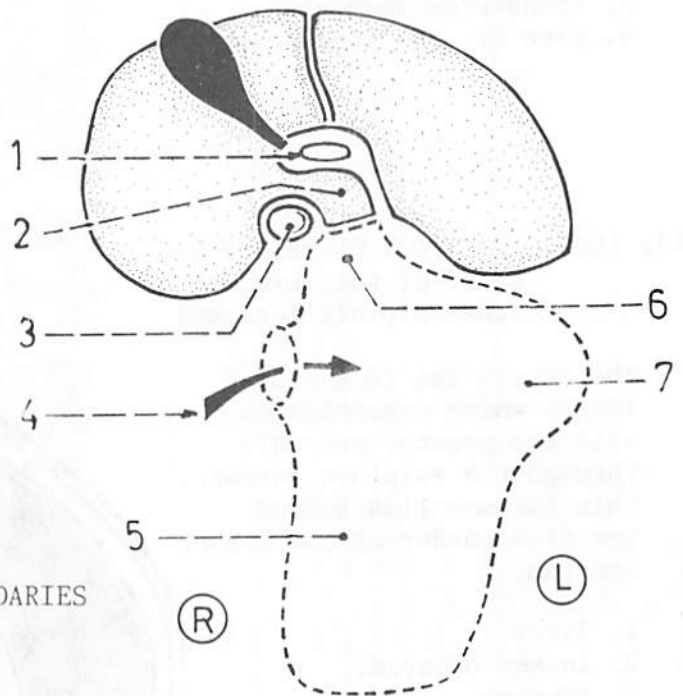


Fig.(101): ANTERIOR AND POSTERIOR BOUNDARIES OF EPIPLOIC FORAMEN

1. anterior boundary: formed by free border of lesser omentum which contains portal vein, bile duct and hepatic artery.
2. arrow in the epiploic foramen.
3. posterior boundary: formed by the inferior vena cava.
4. lesser sac.

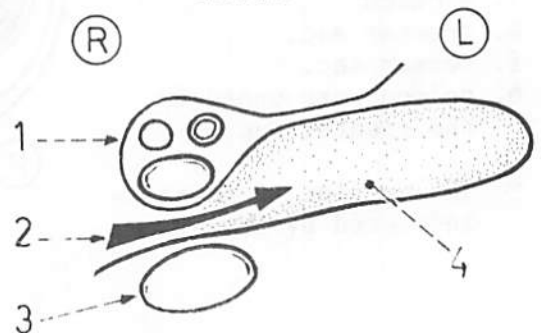


Fig.(102): UPPER AND LOWER BOUNDARIES OF EPIPLOIC FORAMEN

The upper boundary is formed by the caudate process of the liver, while the lower boundary is formed by the 1st part of the duodenum. At this lower boundary the portal vein curves forwards away from the inferior vena cava to enter the free border of the lesser omentum.

1. porta hepatis receiving the portal vein.
2. portal vein in the anterior boundary of the foramen.
3. 1st part of duodenum forming the lower boundary of the foramen.
4. neck of pancreas.
5. caudate process of liver forming the upper boundary.
6. epiploic foramen.
7. inferior vena cava.

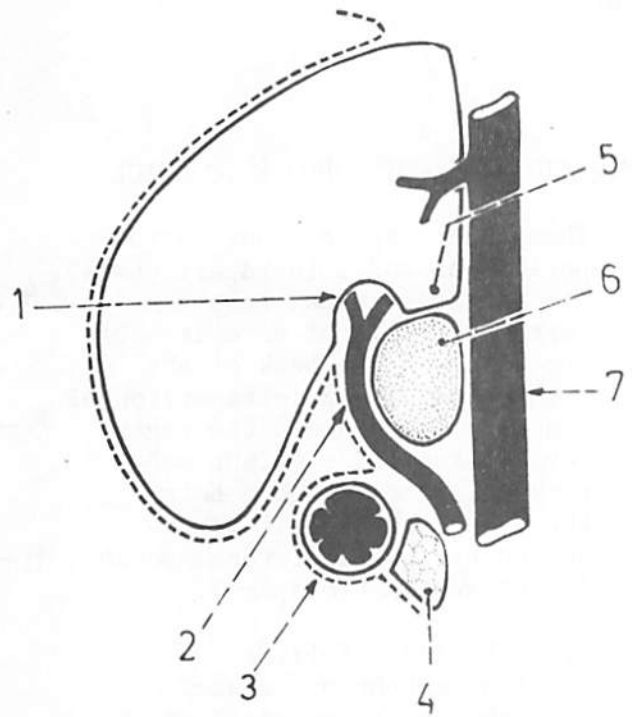


Fig.(103): LEFT SUBPHRENIC SPACES

These are 3 spaces (one extra-peritoneal and 2 intraperitoneal). The extraperitoneal space lies around the left suprarenal gland. The intraperitoneal spaces lie one above the left lobe of liver (part of greater sac) and one below the liver (lesser sac).

1. left lobe of liver.
2. left subphrenic space (intraperitoneal).
3. diaphragm.
4. lesser sac (left subhepatic space).
5. left extraperitoneal subphrenic space (around left suprarenal gland).
6. inferior recess of lesser sac.
7. greater sac of peritoneum.

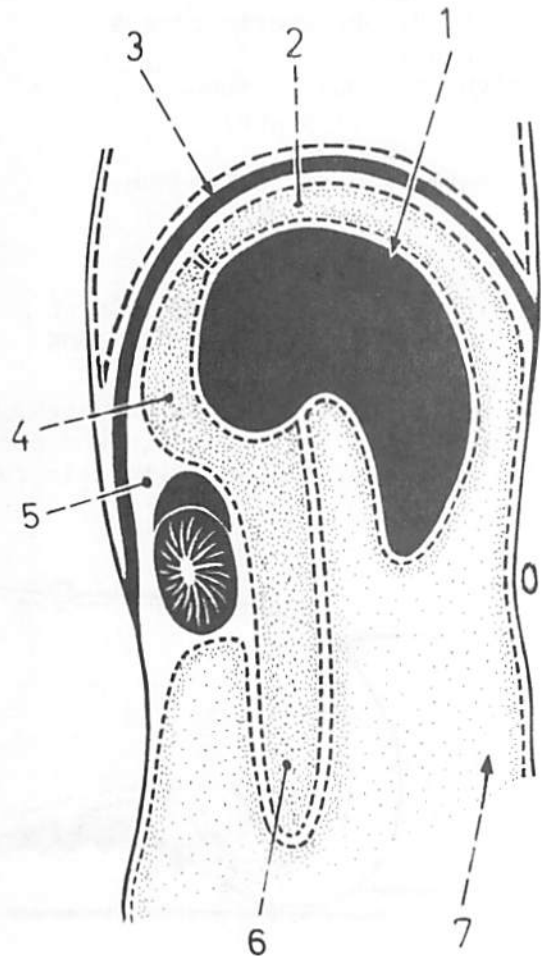


Fig.(104): RIGHT SUBPHRENIC SPACES

These are 3 spaces (one extra-peritoneal and 2 intraperitoneal). The extraperitoneal space is represented by the bare area of the liver on the back of the right lobe. The 2 intraperitoneal spaces lie one above the right lobe of the liver (right subphrenic space) and one below the right lobe and is represented by the hepatorenal pouch (right subhepatic space).

1. right lobe of liver.
2. right subphrenic space.
3. right extraperitoneal space (opposite the bare area of the liver).
4. diaphragm.
5. costo-diaphragmatic recess of pleura.
6. right subhepatic space (hepatorenal pouch).
7. right kidney.
8. greater sac of peritoneum.

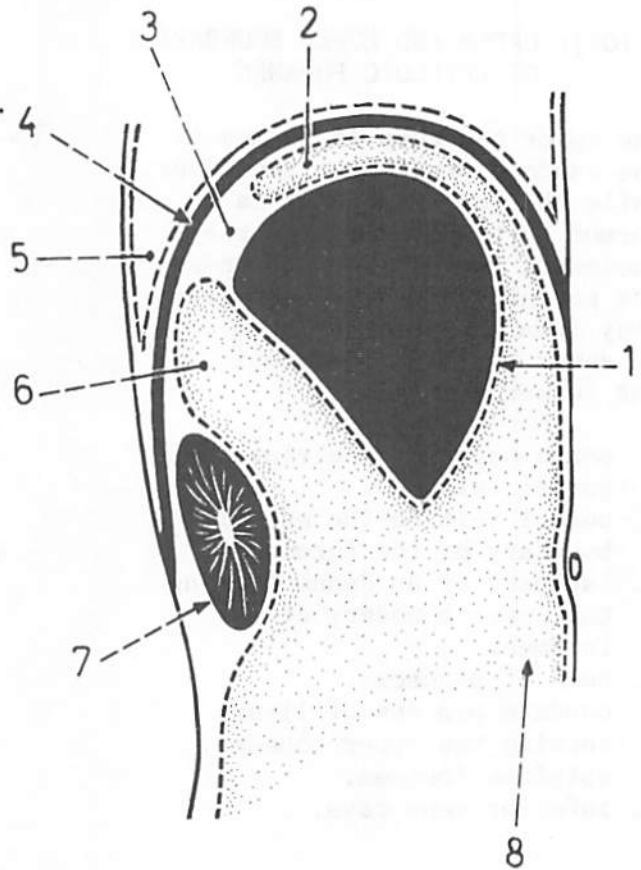


Fig.(105): MOST DEPENDENT PERITONEAL SPACES IN THE RECUMBENT POSITION

With the subject lying on the back, abnormal amounts of fluid in the peritoneal cavity tend to accumulate in the most dependent places: the hepatorenal pouch below the liver (1) as well as in the pelvic cavity (2).

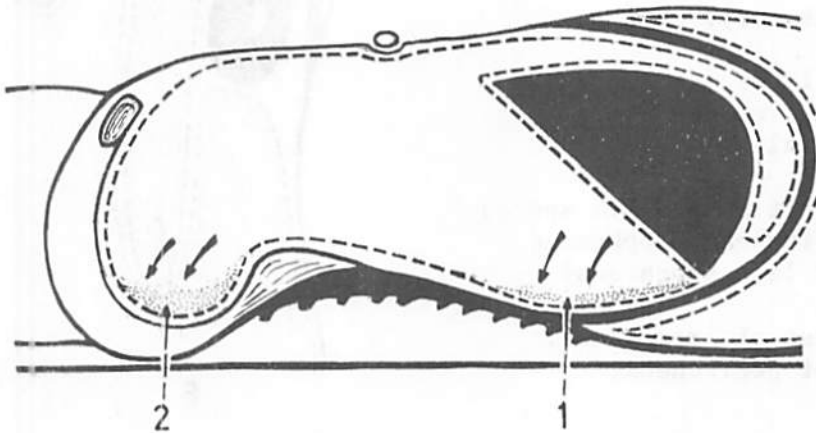


Fig.(106): SUPRACOLIC COMPARTMENT OF PERITONEAL CAVITY

The transverse mesocolon is attached to the posterior abdominal wall along a transverse line extending from the right colic flexure to the left colic flexure. This mesocolon together with the transverse colon divide the peritoneal cavity into 2 major compartments: supracolic compartment (above it) and infracolic compartment (below it).

The supracolic compartment extends from the transverse mesocolon below to the diaphragm above and comprises the 6 subphrenic spaces. 3 of these spaces lie to the right of the falciform ligament in relation to the right lobe of the liver, while the other 3 lie to the left of the falciform ligament in relation to the left lobe of the liver. Of each 3 of these spaces one space is extraperitoneal while the other 2 are intraperitoneal. They are named as follows:

- * To the right of falciform ligament: right subphrenic space, right subhepatic space, right extraperitoneal space.
- * To the left of falciform ligament: left subphrenic space, lesser sac (left subhepatic space), left extraperitoneal space.

1. left extraperitoneal space.
2. left subphrenic space.
3. left subhepatic space (lesser sac).
4. right subphrenic space.
5. right extraperitoneal space (bare area of liver).
6. right subhepatic space (hepatorenal pouch).
7. transverse mesocolon.
8. infracolic compartment.

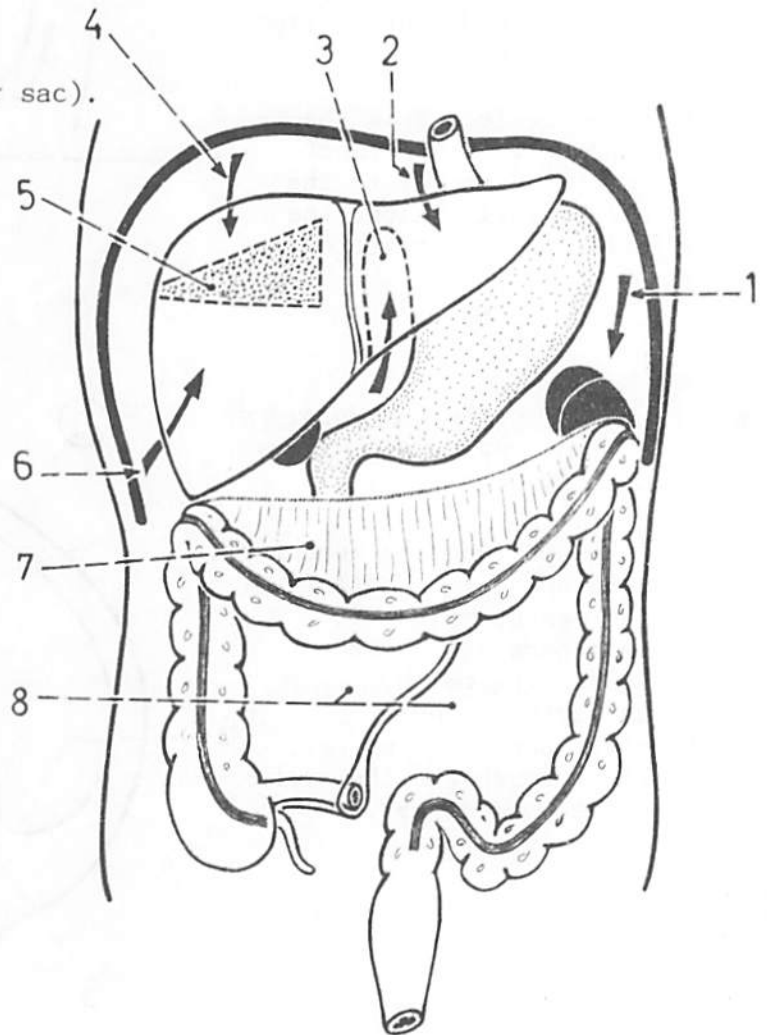


Fig.(107): INFRACOLIC COMPARTMENT OF PERITONEAL CAVITY

It lies below the transverse mesocolon and is subdivided into right and left spaces by the mesentery of small intestine. The left space communicates with the pelvic cavity but the right one is closed by the attachment of the mesentery at the ileo-caecal junction.

1. right space of infracolic compartment.
2. right paracolic gutter.
3. pelvic cavity.
4. mesentery of small intestine.
5. left paracolic gutter.
6. left space of infracolic compartment.

* Fluid collected in the supracolic compartment can find its way to the pelvic cavity along the right paracolic gutter.

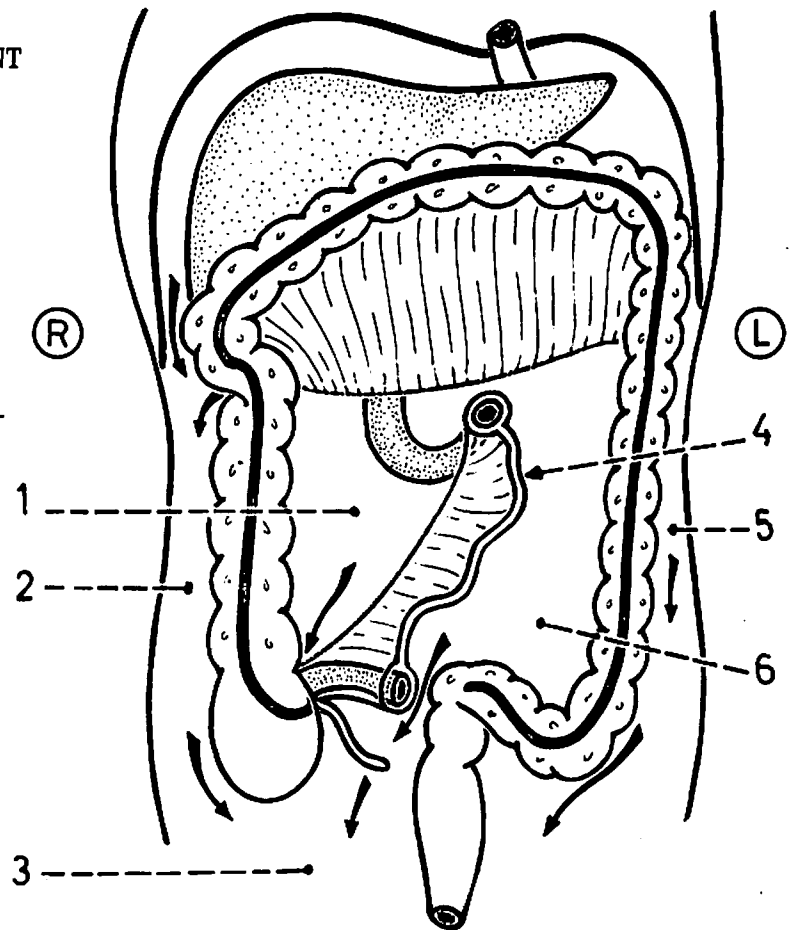
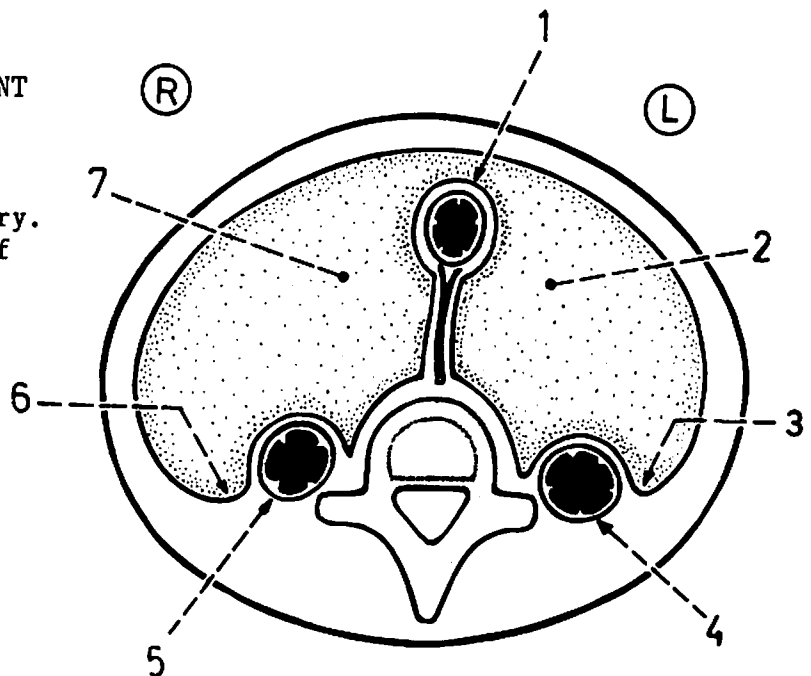


Fig.(108): INFRACOLIC COMPARTMENT OF PERITONEAL CAVITY (T.S.)

1. intestine and its mesentery.
2. left space (to the left of the mesentery).
3. left paracolic gutter.
4. descending colon.
5. ascending colon.
6. right paracolic gutter.
7. right space (to the right of the mesentery).



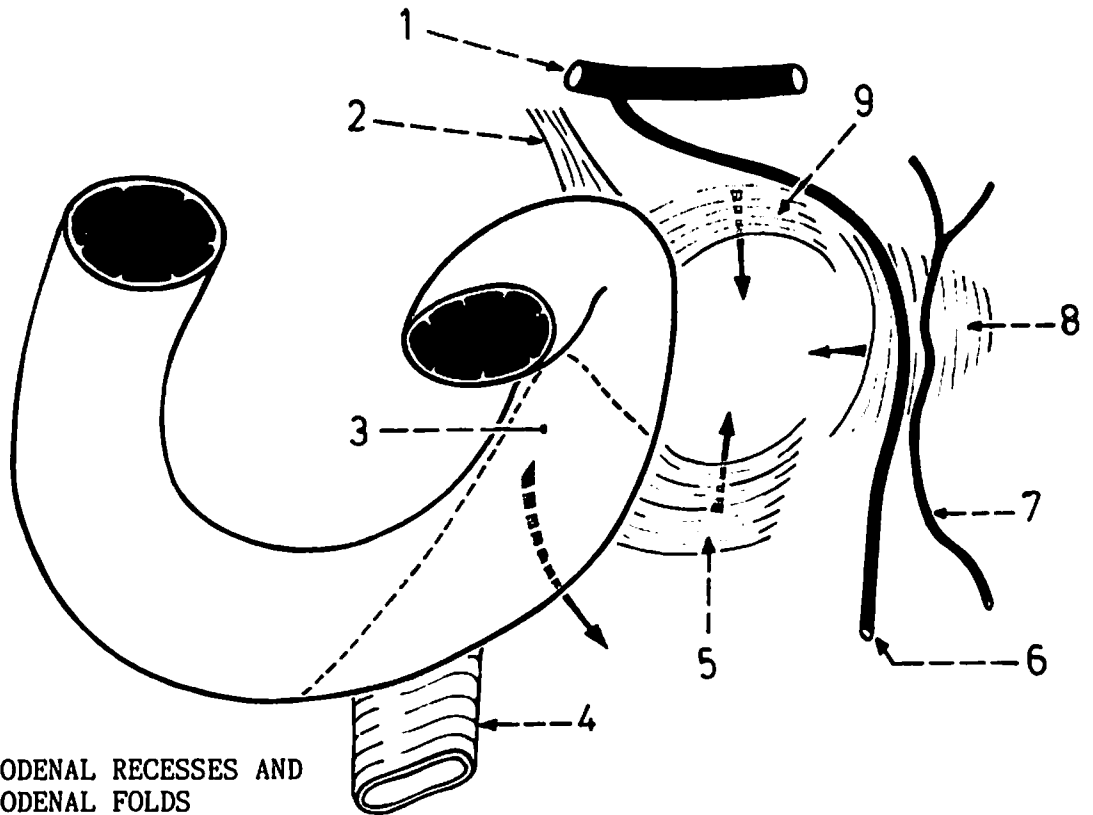


Fig.(109): DUODENAL RECESSES AND DUODENAL FOLDS

The duodenal recesses are: superior duodenal recess (behind superior duodenal fold), inferior duodenal recess (behind inferior duodenal fold), paraduodenal recess (behind paraduodenal fold) and retroduodenal recess (behind the horizontal and ascending parts of the duodenum). The paraduodenal fold is vascular as it contains the inferior mesenteric vein and ascending branch of left colic artery.

1. splenic vein.
2. suspensory ligament of duodenum.
3. retroduodenal recess.
4. aorta.
5. inferior duodenal fold and recess.
6. inferior mesenteric vein.
7. ascending branch of left colic artery.
8. paraduodenal fold and recess.
9. superior duodenal fold and recess.

Fig.(110): DUODENO-JEJUNAL RECESS

It lies just above the duodeno-jejunal flexure.

1. orifice of the recess (directed downwards and to the right).
2. beginning of jejunum.
3. duodenum.
4. head of pancreas.

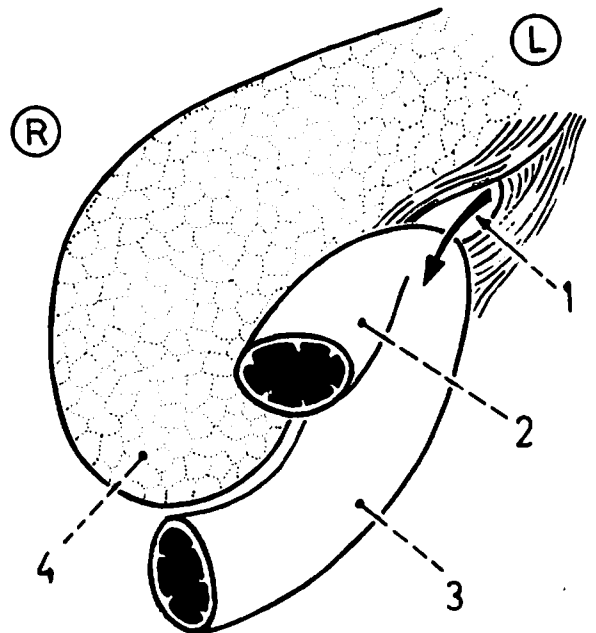


Fig.(111): CAECAL RECESSES AND FOLDS

The caecal recesses are: superior ileo-caecal recess (behind the vascular fold of caecum), inferior ileo-caecal recess (behind the ileo-caecal fold) and retrocaecal recess (behind the caecum).

1. anterior caecal artery.
2. vascular fold of caecum (arches over the anterior caecal artery and superior ileo-caecal recess).
3. bloodless fold (arches over the inferior ileo-caecal recess).
4. mesentery of small intestine.
5. termination of ileum.
6. meso-appendix.
7. vermiform appendix.
8. retrocaecal recess (behind the caecum).
9. caecum.

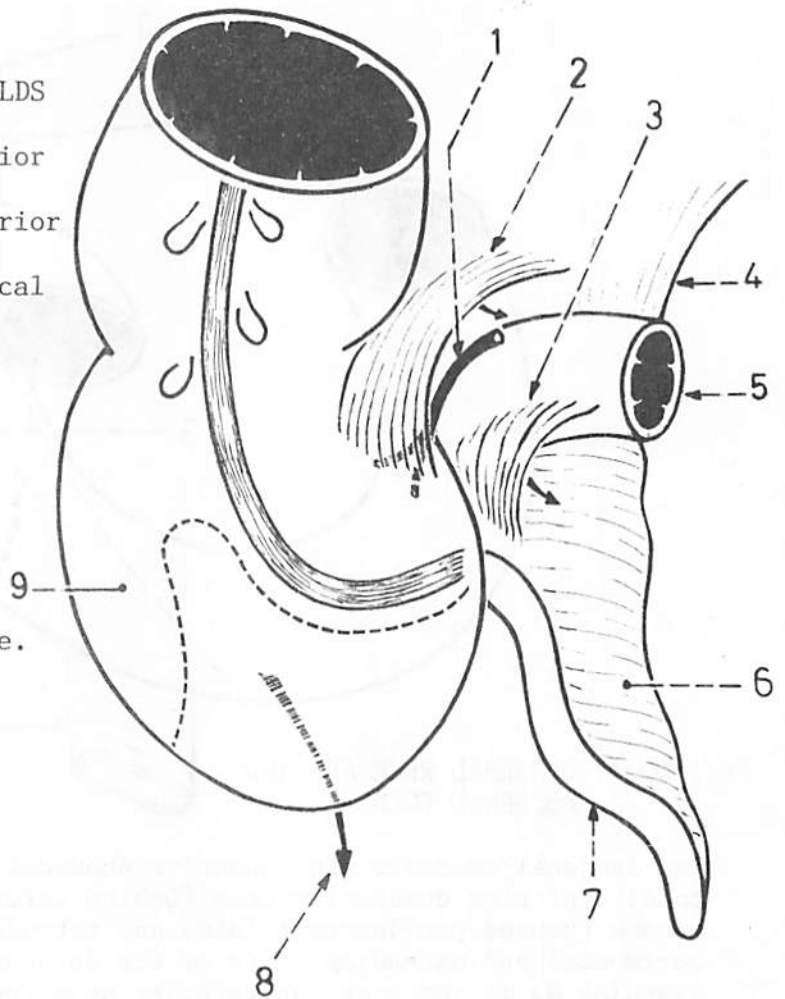


Fig.(112): LIMBS OF SIGMOID MESOCOLON AND INTERSIGMOID RECESS

The sigmoid mesocolon has medial and lateral limbs which form together an inverted V-shape with its apex directed upwards. The intersigmoid recess lies behind this apex overlying the left ureter. The orifice of this recess is directed downwards.

1. inferior mesenteric artery.
2. medial limb of sigmoid mesocolon.
3. superior rectal artery.
4. arrow into the intersigmoid recess.
5. left ureter descending behind the apex of the mesocolon and the recess.
6. lateral limb of sigmoid mesocolon.
7. sigmoid arteries.

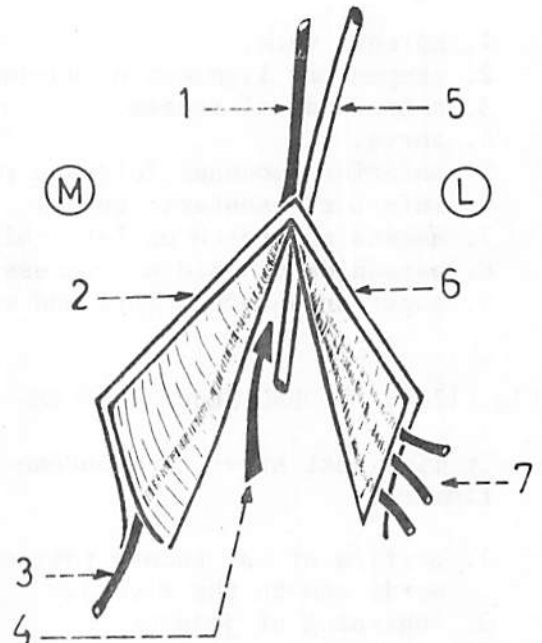


Fig.(113): UMBILICAL FOLDS AND RELATED PERITONEAL FOSSAE
(as seen from the inner aspect of the anterior abdominal wall)

The peritoneum lining the lower part of the anterior abdominal wall shows 5 longitudinal ridges called umbilical folds (one median, 2 medial and 2 lateral). These ridges (folds) form the boundaries of 3 peritoneal fossae on each side of the midline called supramesic, medial inguinal and lateral inguinal fossae (from medial to lateral).

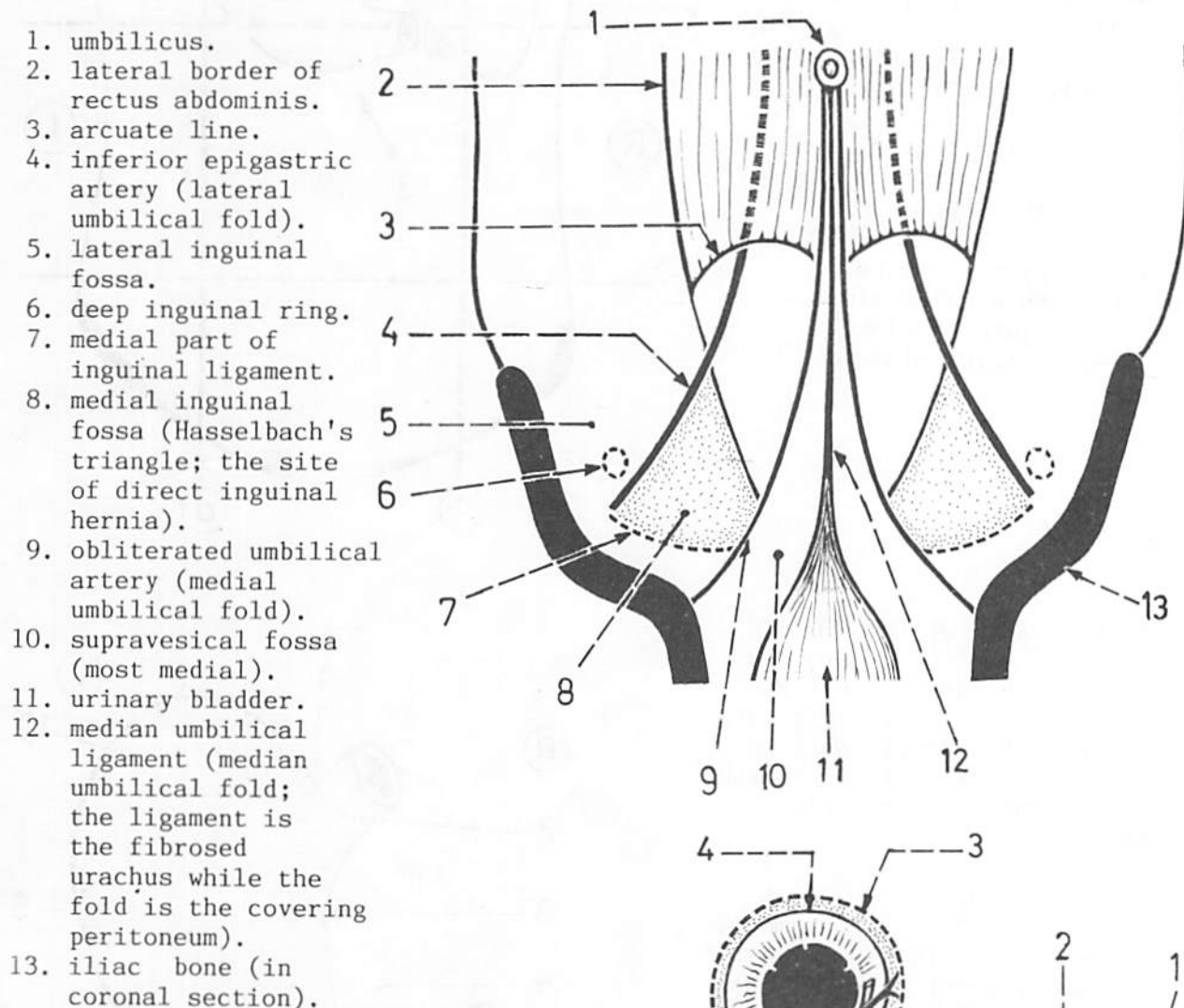
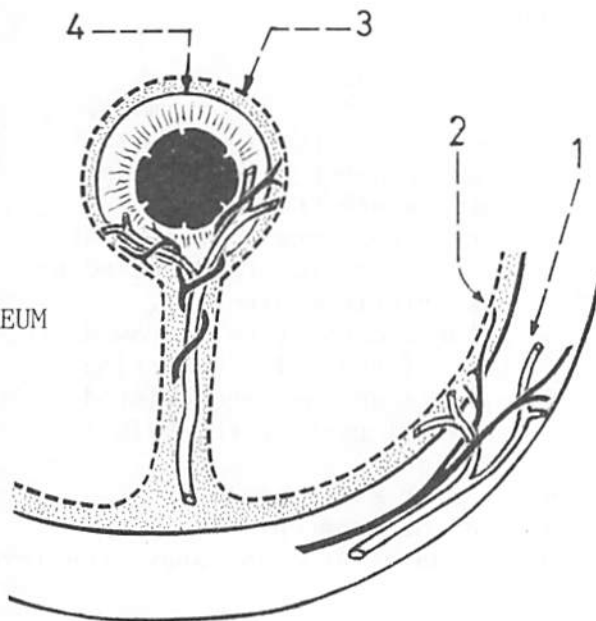


Fig.(114): NERVE AND BLOOD SUPPLY OF PERITONEUM

The parietal peritoneum is supplied by nerves and vessels of the abdominal wall, while the visceral peritoneum is supplied by those of the viscera.

1. abdominal wall.
2. parietal peritoneum.
3. visceral peritoneum.
4. viscus.



ABDOMINAL VISCERA

STOMACH

Fig.(115): POSITION OF THE STOMACH

The stomach lies in the epigastric, umbilical and left hypochondriac regions of the abdominal cavity.

1. epigastric region.
2. left hypochondriac region.
3. umbilical region.

- (a) transpyloric plane.
- (b) transtubercular plane.
- (c) right lateral plane.
- (d) left lateral plane.

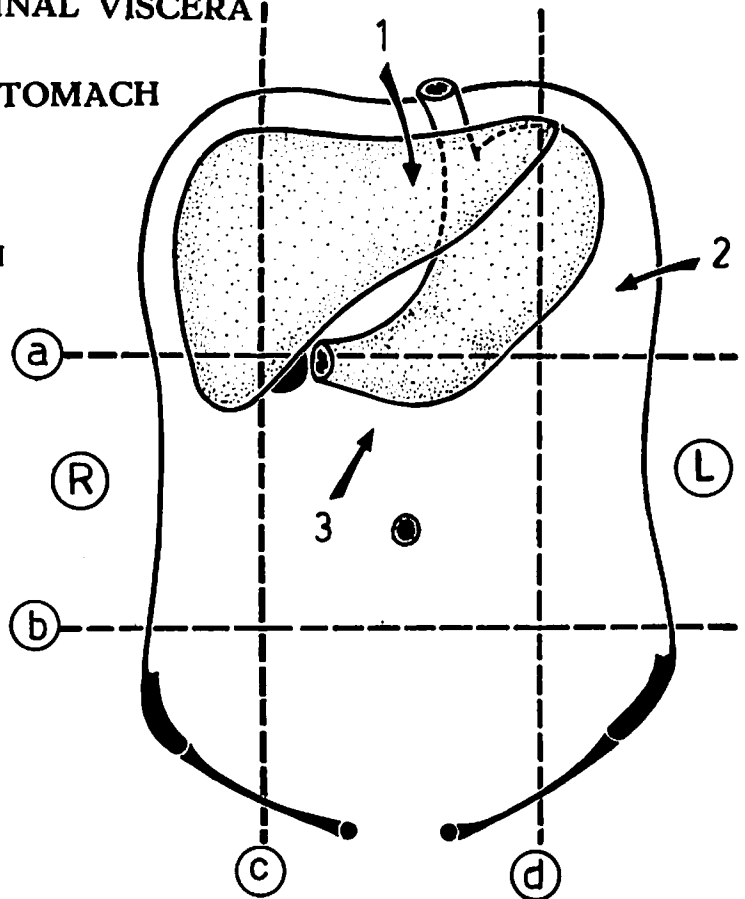


Fig.(116): PARTS OF THE STOMACH

The stomach has the following parts: fundus, body and pyloric portion. The pyloric portion consists of the pyloric antrum, pyloric canal and pyloric sphincter.

1. cardiac notch.
2. cardiac end of the stomach.
3. lesser curvature.
4. angular notch (lies at the point where the lesser curvature turns to the right).
5. pyloric orifice (surrounded by the pyloric sphincter).
6. pyloric canal (the narrow distal part of the pyloric portion).
7. pyloric antrum (the dilated proximal part of the pyloric portion).
8. greater curvature.
9. body of stomach.
10. fundus of stomach (above the level of the cardiac orifice).

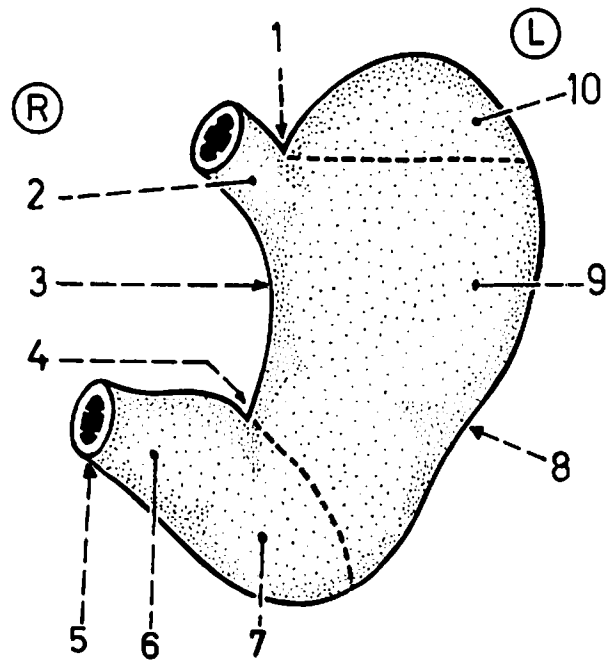


Fig.(117): SURFACE ANATOMY OF THE STOMACH

1. highest point of the fundus: lies opposite the 5th intercostal space in the midclavicular line (just below the left nipple and close to the apex of the heart).
2. cardiac orifice: lies 1 inch to the left of the median plane, opposite the 7th costal cartilage (11th thoracic vertebra).
3. pyloric orifice: lies 1 inch to the right of the median plane at the level of 1st lumbar vertebra (in the transpyloric plane).
4. median plane.

* This description of surface anatomy is for the stomach with the body in the supine position, but in the erect position the pyloric orifice may descend as far as the 3rd lumbar vertebra (subcostal plane).

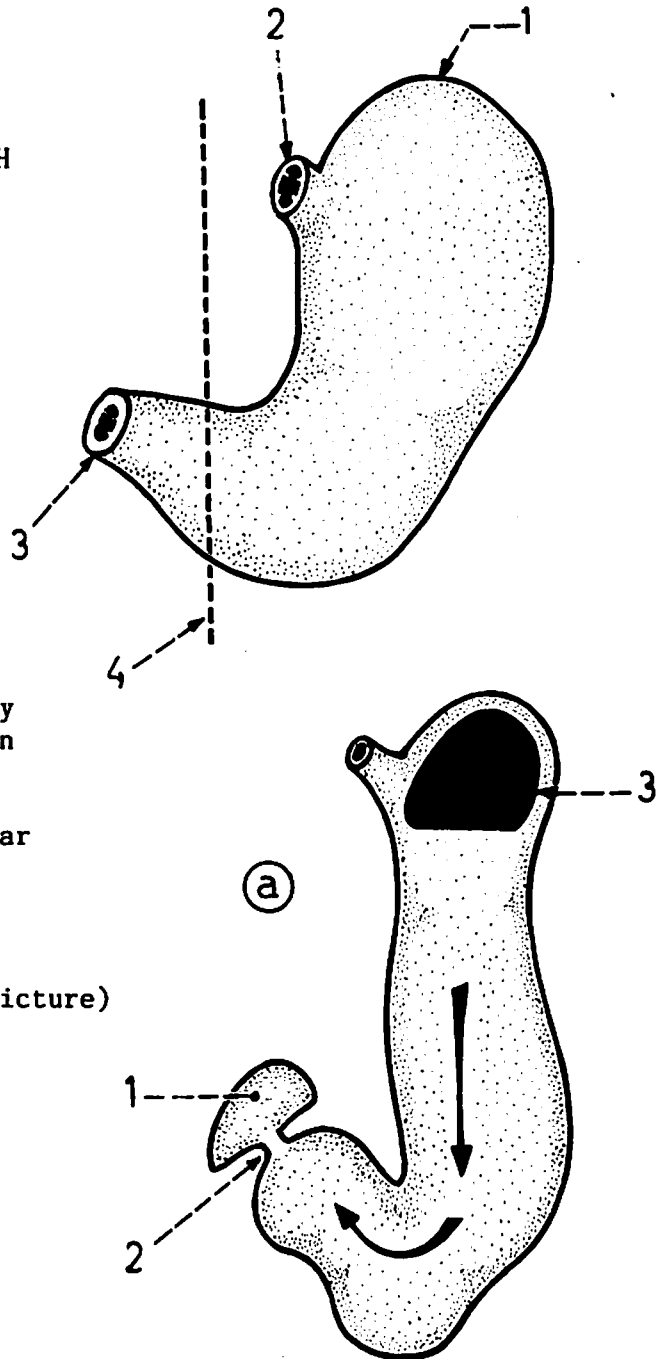


Fig.(118): SHAPE OF THE STOMACH (X-ray picture)

The commonest shape of the stomach is the J-shape, i.e. the stomach has a vertical position. A less common shape is the steer-horn stomach, i.e. the stomach lies transversely.

(a) J-shaped stomach

1. duodenal cap (1st inch of the duodenum).
2. pyloric orifice.
3. air bubble in the fundus.

(b) Steer-horn stomach

1. duodenal cap.
2. pyloric portion.

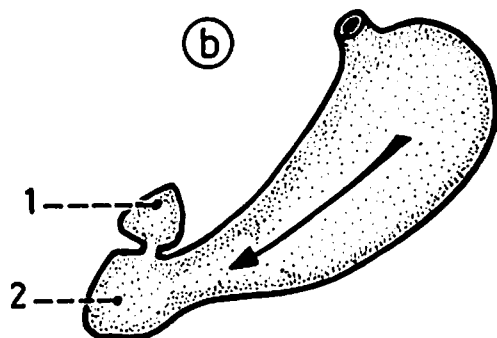


Fig.(119): CARDIAC END OF STOMACH

The cardiac end of the stomach is continuous with the abdominal part of the oesophagus. This part of the oesophagus is $\frac{1}{2}$ an inch long and curves sharply to the left to join the stomach. The right border of the oesophagus continues evenly with the lesser curvature of the stomach, while its left border is separated from the greater curvature by the cardiac notch.

1. paracardial lymph nodes (around the cardiac orifice).
2. anterior and posterior gastric nerves.
3. abdominal part of oesophagus.
4. oesophageal branches of left gastric artery.
5. left gastric artery.

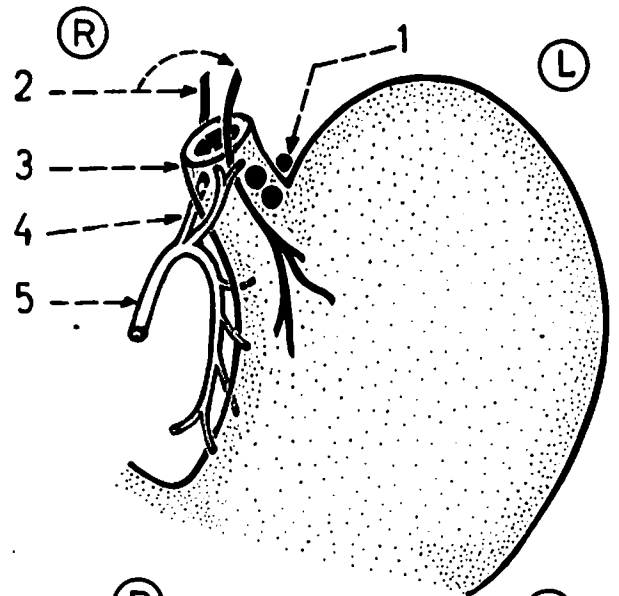


Fig.(120): ANTERIOR RELATIONS OF THE STOMACH

The anterior surface of the stomach is related to: left lobe of the liver (above and to the right), the left 6, 7, 8, 9 ribs and their cartilages, related intercostal spaces and diaphragm (above and to the left) and directly to the anterior abdominal wall (below).

1. left lobe of liver.
2. left ribs.
3. lower part of stomach (directly related to anterior abdominal wall).

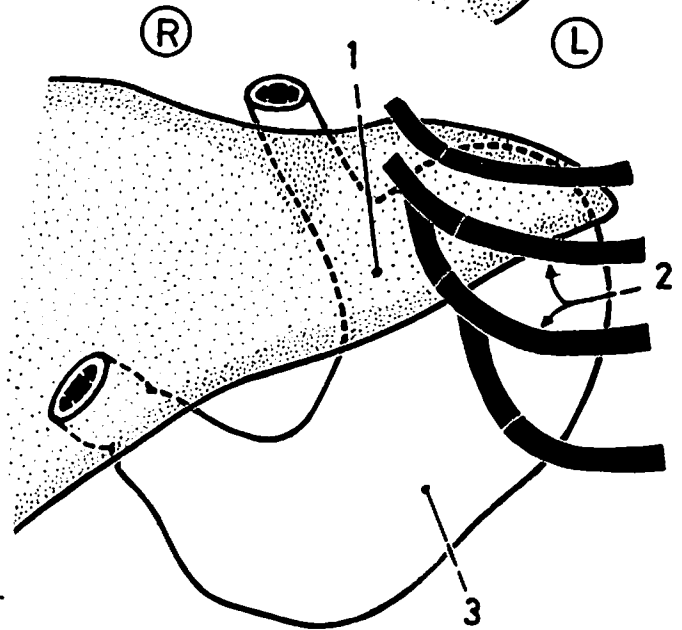


Fig.(121): RELATIONS OF THE STOMACH TO THE LESSER SAC AND GREATER SAC OF PERITONEUM

The stomach has the lesser sac behind it and the greater sac in front of it.

1. lesser sac (behind the stomach).
2. greater sac (in front of the stomach).

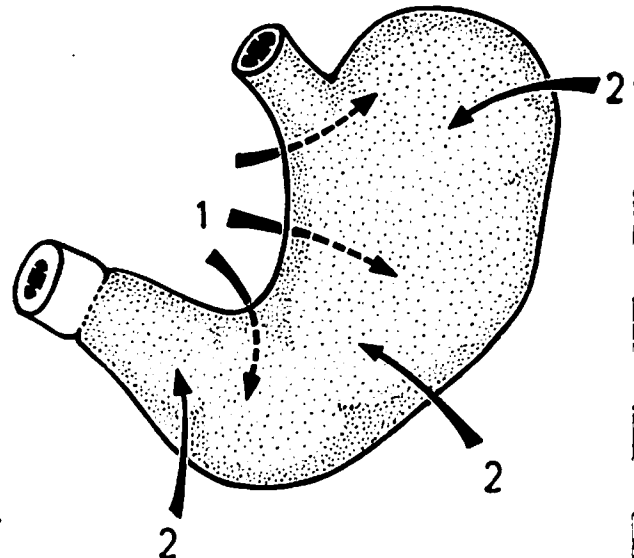
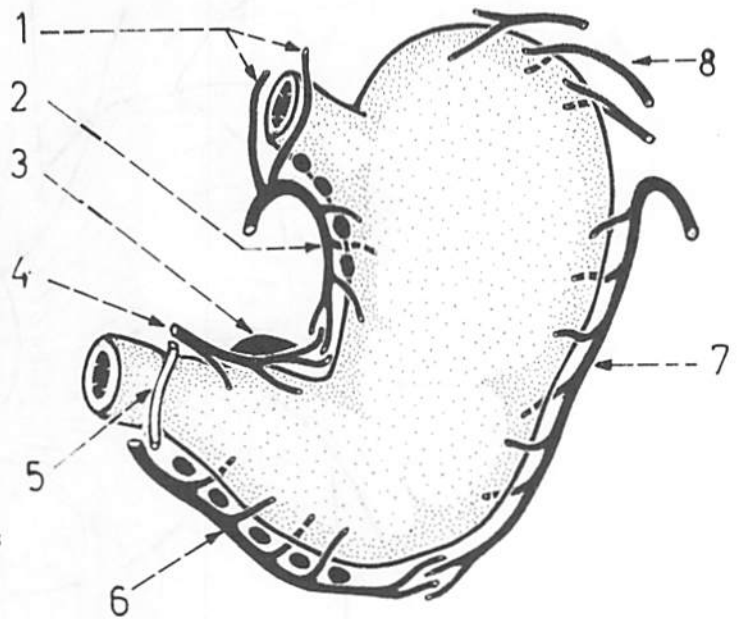


Fig.(122): RELATIONS OF CURVATURES OF THE STOMACH

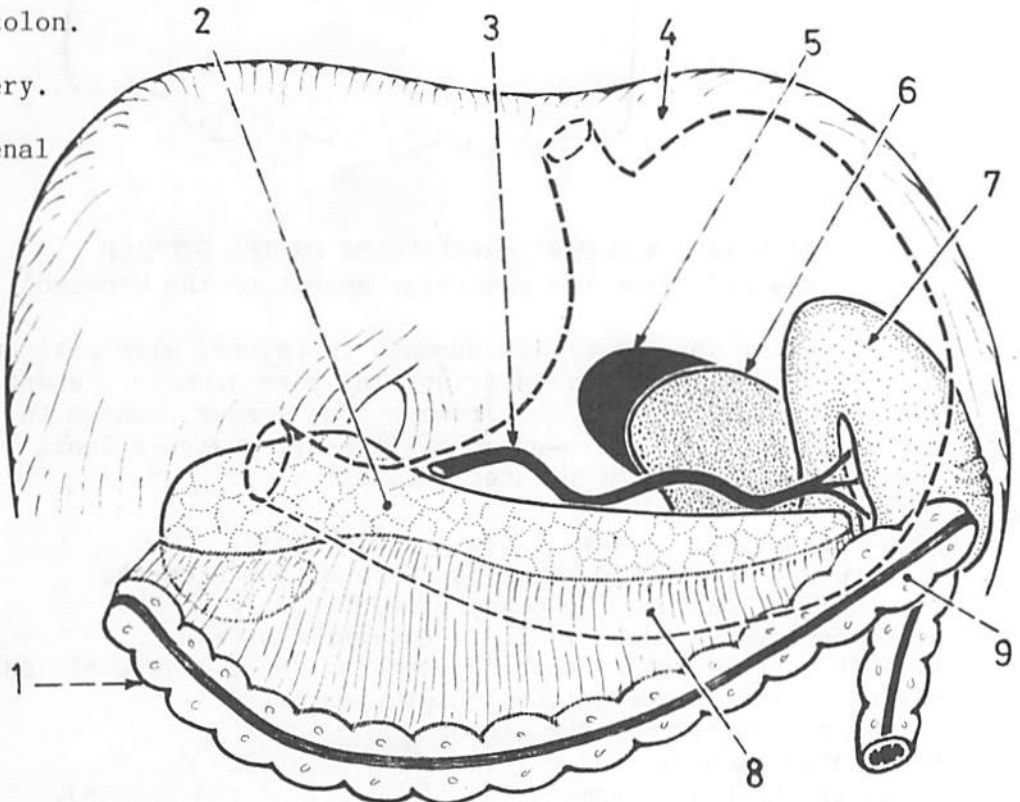
The lesser curvature is related to the right and left gastric vessels and to the left gastric lymph nodes along its upper part. The greater curvature is related to the gastro-epiploic vessels and to lymph nodes along its lower part.



1. oesophageal branches of left gastric artery.
2. left gastric artery and related lymph nodes.
3. omental tuberosity of pancreas (projects above the lesser curvature).
4. right gastric artery.
5. prepyloric vein (in front of the pyloric orifice).
6. right gastro-epiploic artery and related lymph nodes.
7. left gastro-epiploic artery.
8. short gastric arteries (supply the fundus of the stomach).

Fig.(123): STRUCTURES OF THE STOMACH BED (POSTERIOR RELATIONS OF STOMACH)

1. transverse colon.
2. pancreas.
3. splenic artery.
4. diaphragm.
5. left suprarenal gland.
6. left kidney.
7. spleen.
8. transverse mesocolon.
9. left colic flexure.



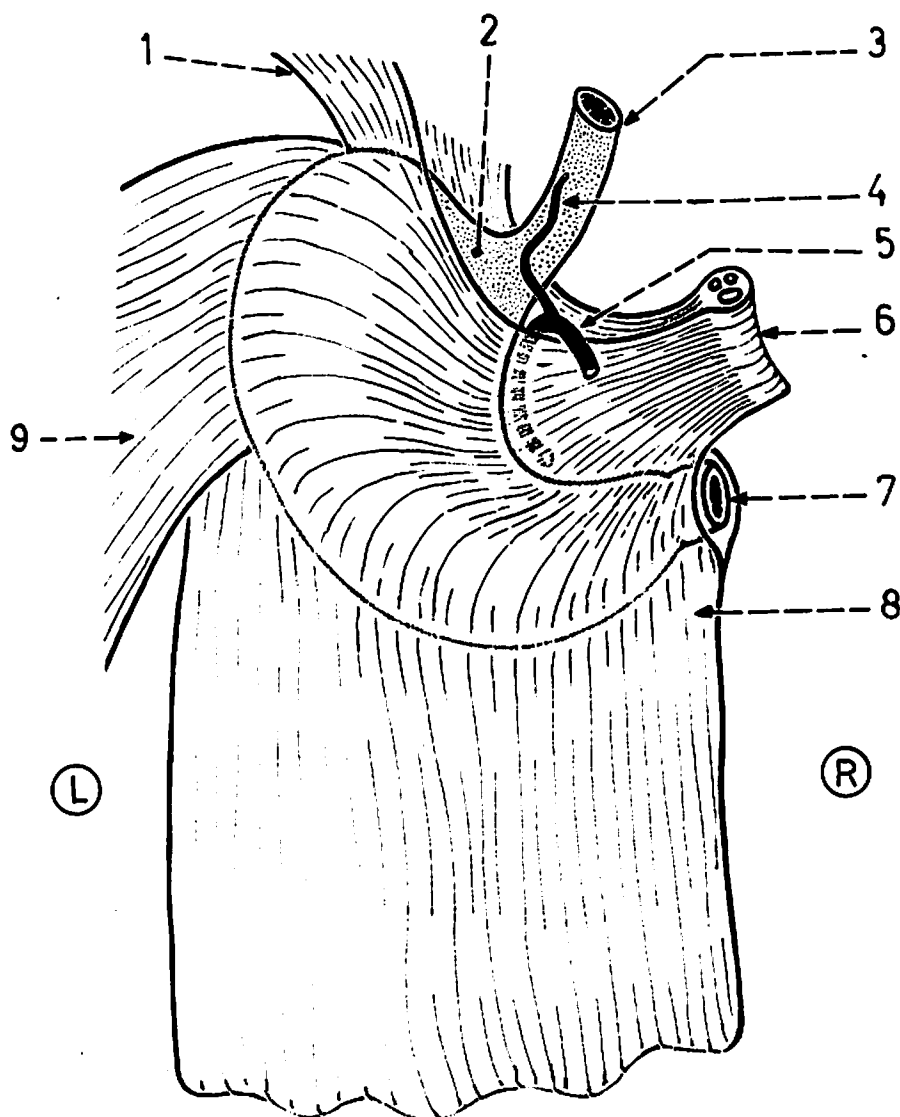


Fig.(124): BARE AREA AND PERITONEAL FOLDS OF THE STOMACH
(as seen from the posterior aspect of the stomach)

The posterior surface of the stomach is covered with peritoneum except at the cardiac orifice where a triangular bare area is present. The peritoneal folds of the stomach are: lesser omentum to the lesser curvature, and the gastro-phrenic ligament, gastro-splenic ligament and greater omentum to the greater curvature.

1. gastro-phrenic ligament (to the diaphragm).
2. bare area on the posterior surface of the stomach.
3. abdominal part of the oesophagus.
4. oesophageal branch of the left gastric artery.
5. left gastric artery entering between the 2 layers of lesser omentum.
6. free right border of the lesser omentum.
7. pyloric orifice of the stomach.
8. greater omentum (has a free lower border).
9. gastro-splenic ligament (to the hilum of the spleen).

Fig.(125): ARTERIES OF THE STOMACH

The arteries of the stomach are: left gastric (from coeliac trunk), right gastric and right gastro-epiploic (from the hepatic branch of coeliac trunk) and short gastric and left gastro-epiploic (from the splenic branch of coeliac trunk).

1. left gastric artery.
2. hepatic artery.
3. gastro-duodenal artery.
4. right gastro-epiploic artery.
5. right gastric artery.
6. left gastro-epiploic artery.
7. short gastric arteries.

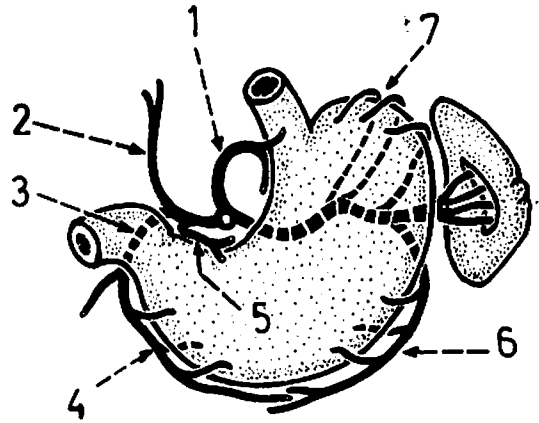


Fig.(126): DISTRIBUTION OF ARTERIES TO THE STOMACH

- (a) area supplied by left gastric artery.
 (b) area supplied by splenic artery.
 (c) area supplied by hepatic artery.

1. left gastric artery.
2. right gastric artery.
3. right gastro-epiploic artery.
4. left gastro-epiploic artery.
5. short gastric arteries.

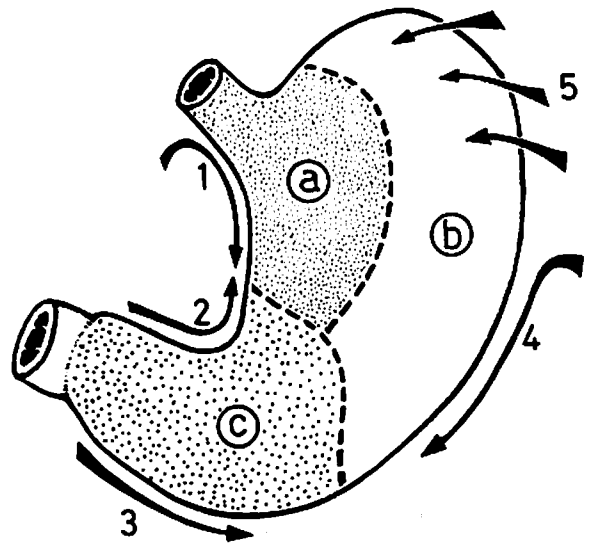
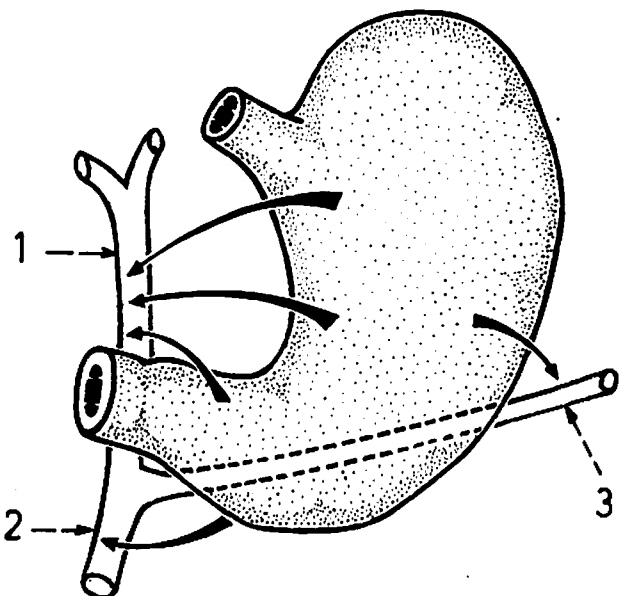


Fig.(127): VEINS OF THE STOMACH

The veins of the stomach drain as follows: the right and left gastric veins join the portal vein, the right gastro-epiploic vein joins the superior mesenteric vein, while the short gastric and left gastro-epiploic veins join the splenic vein.

1. portal vein.
2. superior mesenteric vein.
3. splenic vein.

* It should be noted that the venous blood from the stomach drains into the portal circulation.



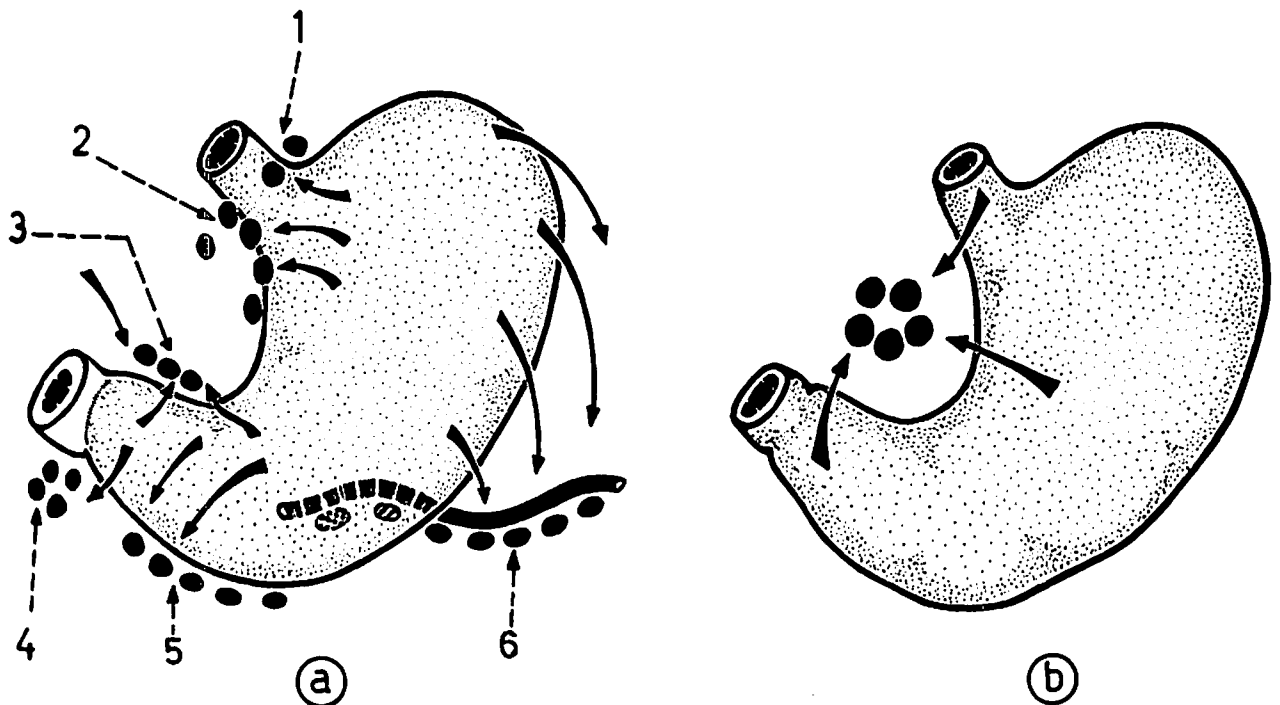


Fig.(128): LYMPHATIC DRAINAGE OF THE STOMACH

The lymph vessels accompany the blood vessels and end in groups of lymph nodes along these vessels; they drain finally into the coeliac nodes.

- (a) regional groups of nodes: 1. paracardial nodes; 2. left gastric nodes; 3. hepatic nodes; 4. pyloric nodes; 5. right gastro-epiploic nodes; 6. pancreatico-splenic nodes.
- (b) coeliac group of nodes: receives lymphatics from all regional groups of the stomach.

Fig.(129): NERVE SUPPLY OF THE STOMACH

The stomach gets its sympathetic fibres from the coeliac plexus around coeliac trunk, and gets its parasympathetic fibres from both vagi.

1. right vagus.
2. thoracic oesophagus.
3. posterior gastric nerve (from right vagus).
4. coeliac plexus of nerves.
5. left vagus.
6. oesophageal opening of diaphragm.
7. anterior gastric nerve (from left vagus).

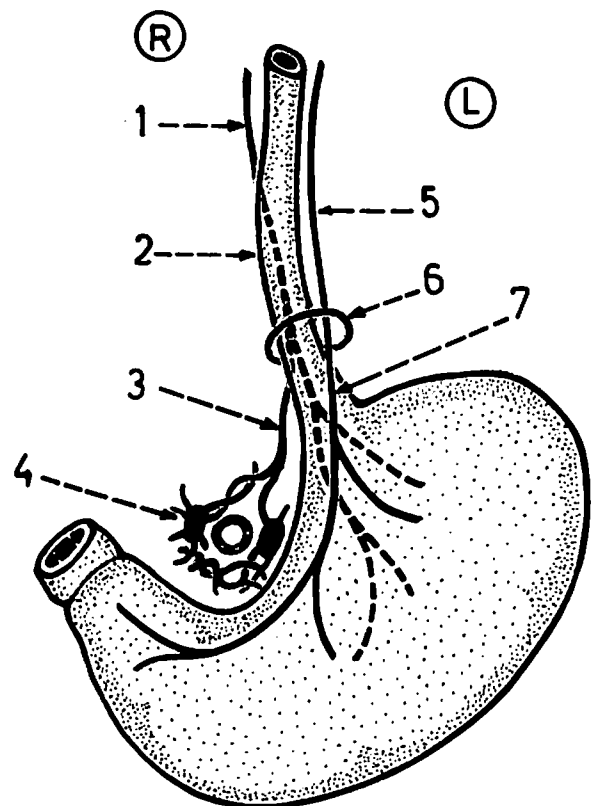


Fig.(130): MUSCULAR COAT OF THE STOMACH

The muscular coat of the stomach consists of 3 layers: outer longitudinal, middle circular and inner oblique.

1. outer longitudinal layer: well-developed all over the stomach wall.
2. middle circular layer: less developed at the fundus but is well-developed at the pylorus to form the pyloric sphincter.
3. inner oblique layer: mainly found in the region of the fundus.

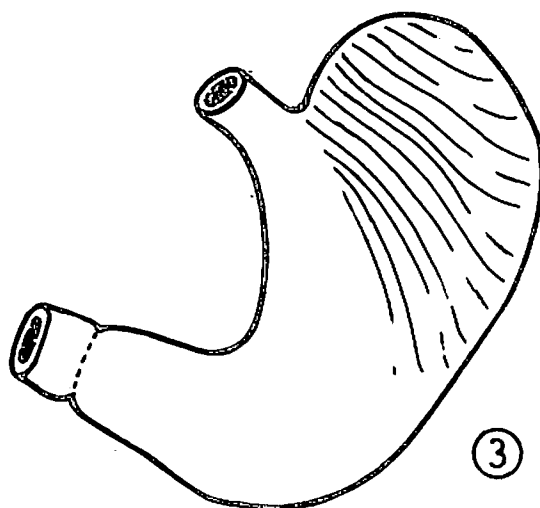
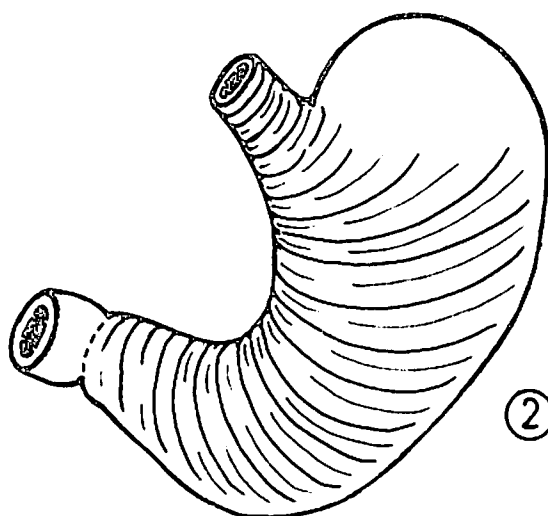
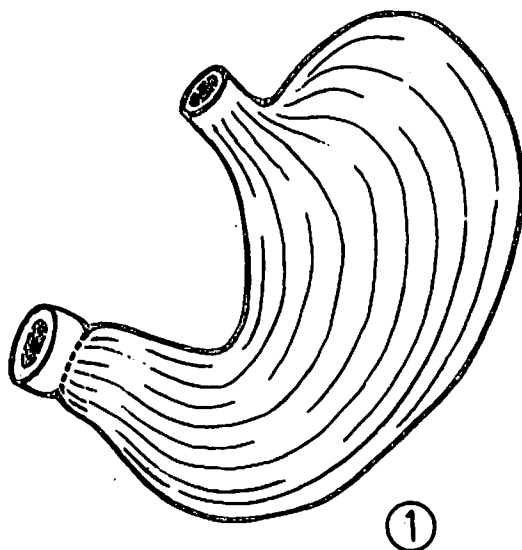
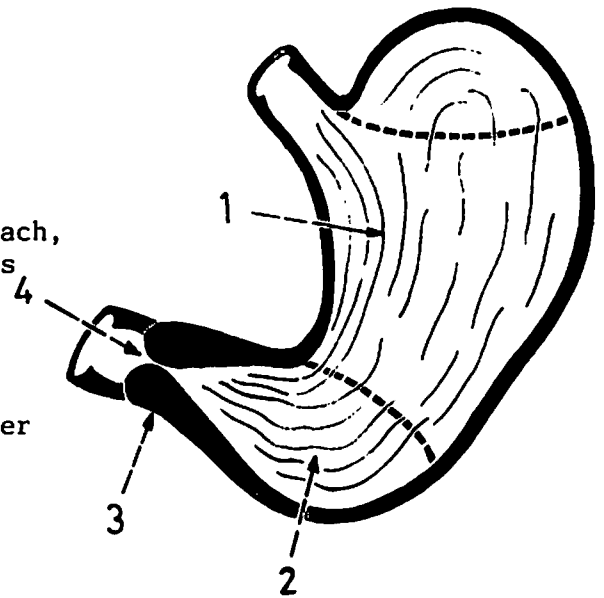


Fig.(131): RUGAE OF THE MUCOUS MEMBRANE OF THE STOMACH

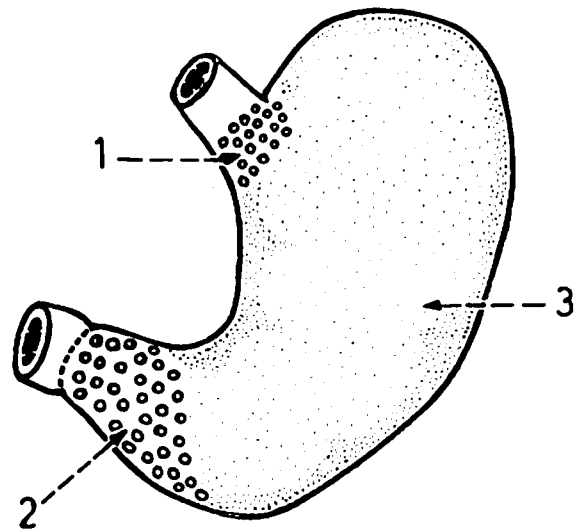
During the contracted state of the stomach, its mucous membrane is thrown into folds called rugae which run mainly in a longitudinal direction. They are best marked at the pyloric end and along the greater curvature. A longitudinal canal lies between these rugae along the lesser curvature extending from the cardiac orifice down to the angular notch and is called the gastric canal.



1. longitudinal rugae in the body of the stomach.
2. well-marked rugae in the pyloric portion of the stomach.
3. pyloric sphincter.
4. pyloric orifice.

Fig.(132): GASTRIC GLANDS IN THE MUCOSA OF THE STOMACH

The gastric glands situated near the cardiac orifice and the pyloric orifice are mainly mucus-secreting glands, while those in the fundus and body of the stomach secrete pepsin and hydrochloric acid.



1. cardiac glands: secrete mucus.
2. pyloric glands: secrete mucus.
3. body glands: secrete pepsin and hydrochloric acid.

SMALL INTESTINE

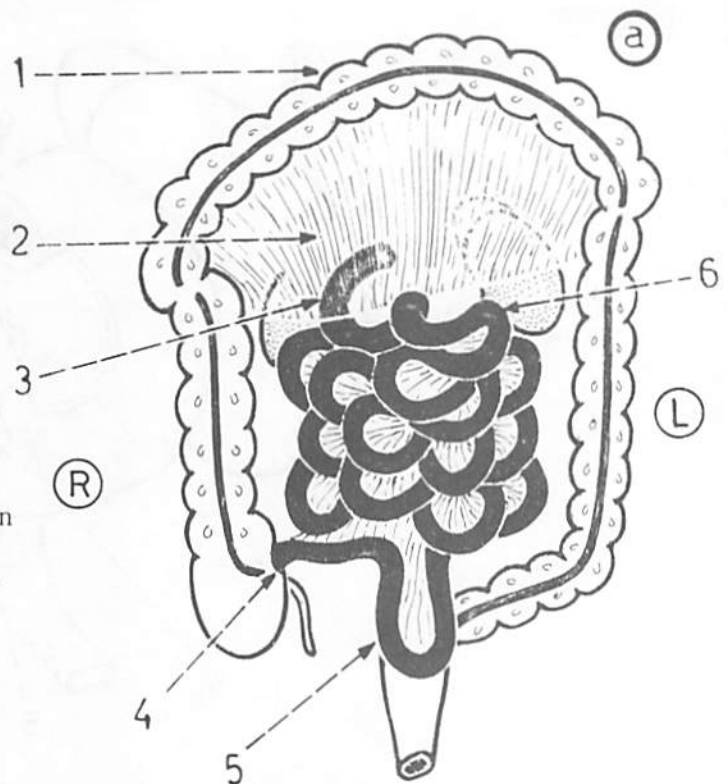
Fig.(133): SMALL INTESTINE
AS A WHOLE

The small intestine consists of 3 parts: duodenum (with no mesentery), jejunum and ileum (with a mesentery). It extends from the pylorus to the ileo-caecal junction.

(a) position of small intestine
(anterior view)

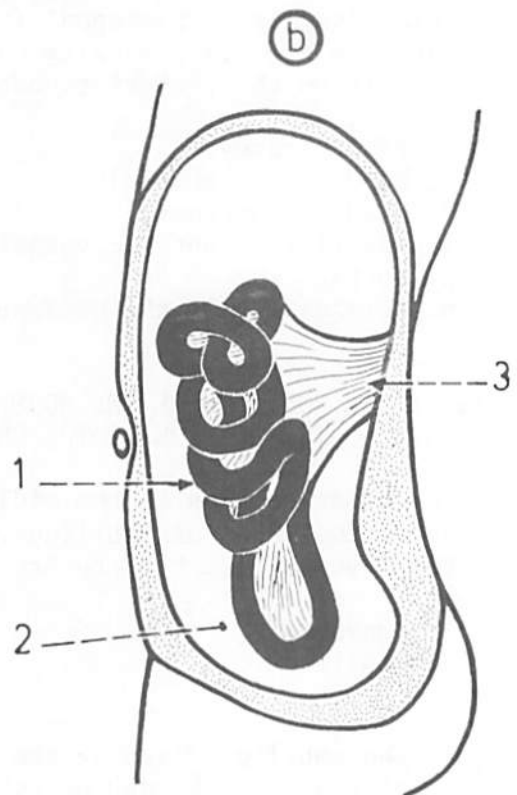
The small intestine lies in the central and lower parts of the abdominal cavity within the curve of the large intestine, i.e. in the infra-colic compartment of the greater sac.

1. transverse colon (reflected upwards).
2. transverse mesocolon (reflected upwards).
3. duodenum (the 1st part of the small intestine).
4. ileo-caecal junction (receives the terminal part of ileum).
5. a loop of ileum extending into the pelvic cavity in front of the rectum.
6. a jejunal loop in front of the left kidney.



(b) Position of small intestine
(side view)

1. loops of small intestine in the central and lower parts of abdominal cavity.
2. a loop of ileum in the pelvic cavity.
3. mesentery of the small intestine suspending it to the posterior abdominal wall.



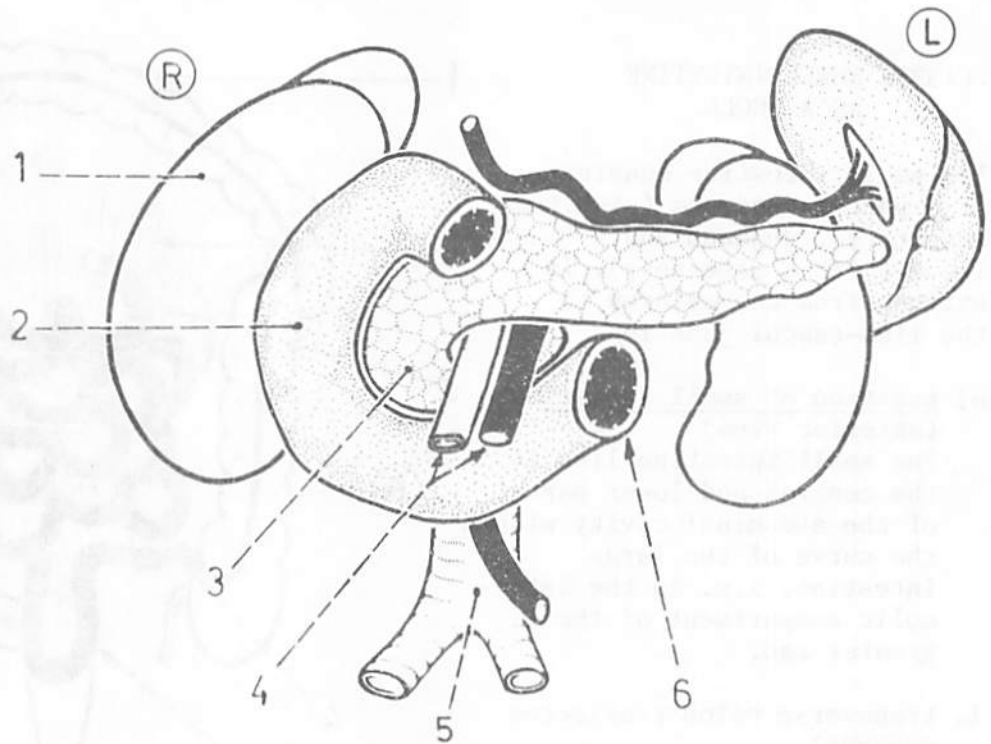
DUODENUM

Fig.(134): SHAPE AND POSITION OF THE DUODENUM

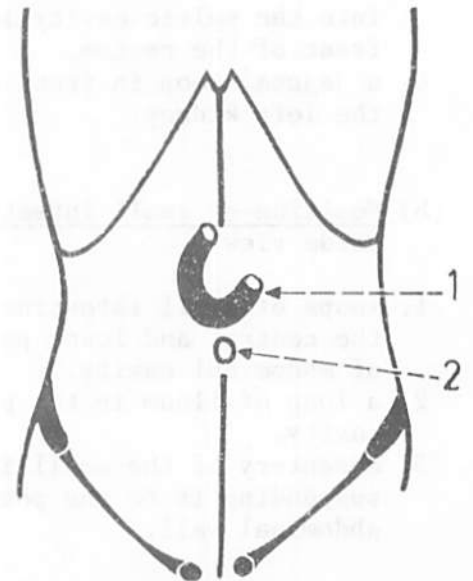
The duodenum is the shortest, widest and most fixed part of the small intestine. It is C-shaped with its concavity curving around the head of the pancreas and its convexity overlapping the right kidney, right ureter and vessels on the posterior abdominal wall.

1. right kidney.
2. duodenum (C-shaped).
3. head of pancreas.
4. superior mesenteric vessels.
5. aorta.
6. termination of the duodenum.

Fig.(135): POSITION OF THE DUODENUM
IN RELATION TO THE UMBILICUS

The duodenum lies in the midline above the level of umbilicus, from the level of 1st L.V. to 3rd L.V.

1. duodenum.
2. umbilicus.



* The umbilicus lies at the level of the upper border of 4th lumbar vertebra (4th L.V.).

Fig.(136): PARTS OF THE DUODENUM

The duodenum is formed of 4 parts called 1st part (superior), 2nd part (descending), 3rd part (horizontal or inferior) and 4th part (ascending).

1. 1st (superior) part: it is 2 inches long and passes upwards, backwards and to the right.
2. 2nd (descending) part: it is 3 inches long and descends vertically downwards.
3. 3rd (horizontal) part: it is 4 inches long and passes horizontally from right to left.
4. 4th (ascending) part: it is 1 inch long and ascends to end at the duodeno-jejunal flexure.

* The duodenum is 10 inches long.

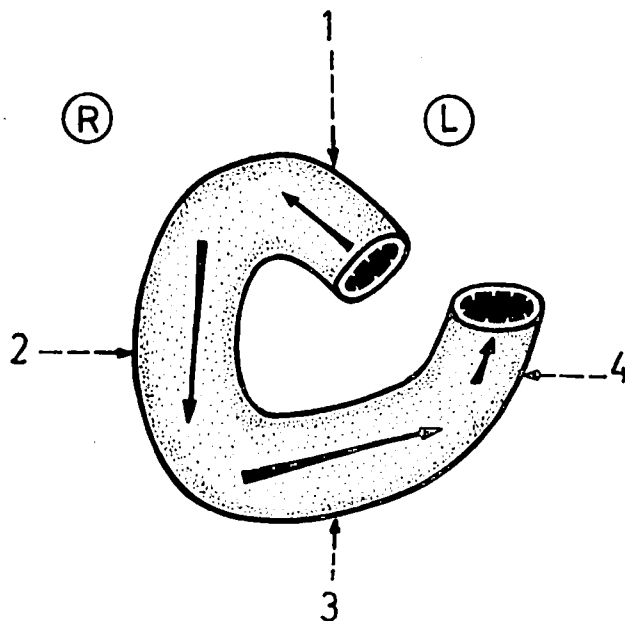
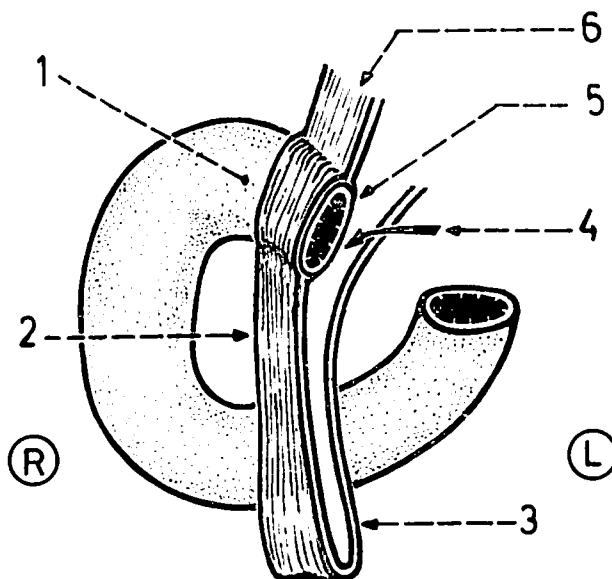


Fig.(137): PERITONEAL RELATIONS OF THE DUODENUM

The duodenum lies behind the peritoneum (retroperitoneal) except the proximal inch of its superior part which gives attachment to 2 peritoneal folds (lesser omentum above and greater omentum below, as the stomach).

1. distal inch of superior (1st) part of duodenum (retroperitoneal).
2. anterior 2 layers of greater omentum.
3. posterior 2 layers of greater omentum.
4. lesser sac behind the proximal inch of superior part.
5. proximal inch of superior part of duodenum.
6. lesser omentum.



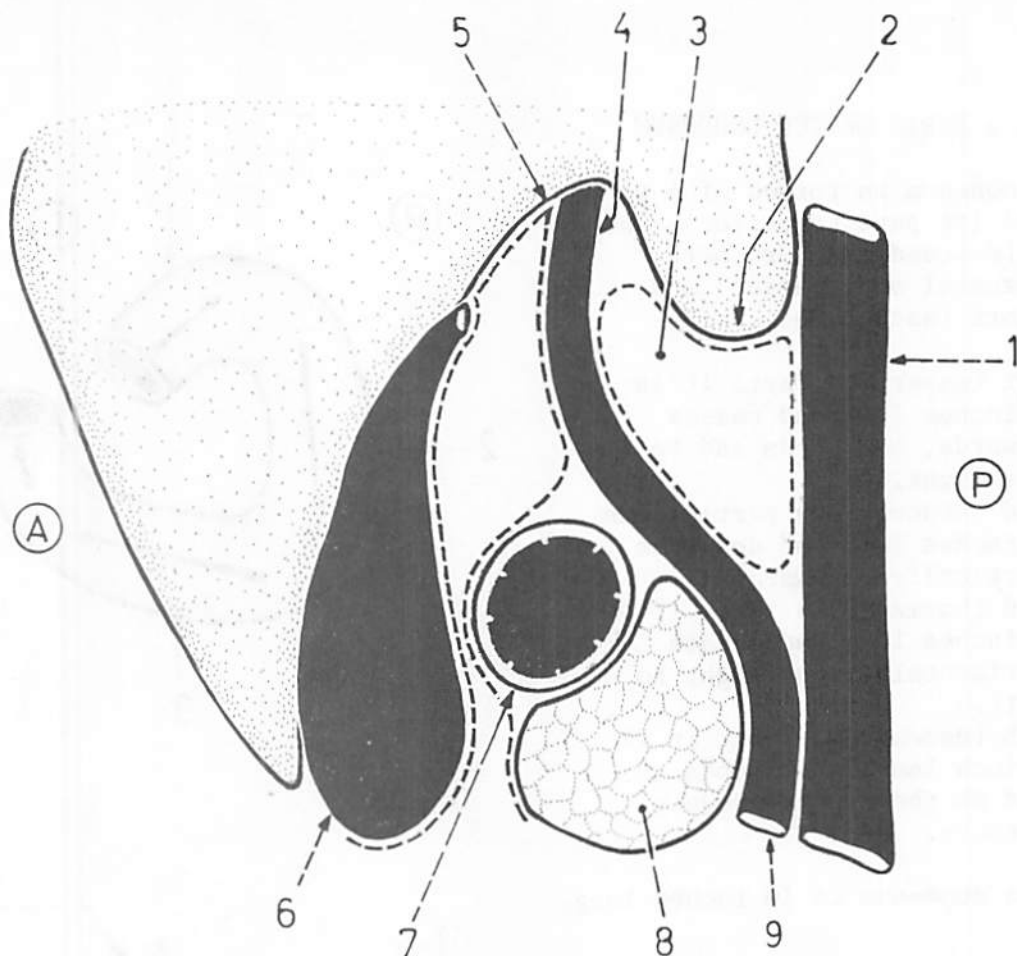


Fig.(138): SOME RELATIONS OF SUPERIOR PART OF THE DUODENUM (sagittal section)

The superior (1st) part of the duodenum has the following relations:

- * anteriorly: gall bladder and quadrate lobe of the liver.
- * posteriorly: portal vein and structures in front of it (bile duct and gastro-duodenal artery).
- * above: epiploic foramen.
- * below: head and neck of pancreas.

1. inferior vena cava.
2. caudate process of caudate lobe of the liver forming the upper boundary of the epiploic foramen.
3. epiploic foramen extending from the caudate process above to the 1st part of duodenum below.
4. portal vein where it enters the porta hepatis.
5. porta hepatis.
6. gall bladder (in front of the 1st part of duodenum).
7. cross section of the superior (1st) part of the duodenum.
8. neck of pancreas.
9. beginning of the portal vein (at its beginning, the portal vein lies behind the neck of the pancreas and in front of the inferior vena cava but above the duodenum it is separated from the inferior vena cava by the epiploic foramen).

Fig.(139): RELATIONS OF THE SUPERIOR PART OF THE DUODENUM TO THE GALL BLADDER AND BILE DUCT

The superior part (1st part) of the duodenum lies between 2 main components of the biliary system: body of gall bladder (in front) and middle part of the bile duct (behind).

1. descending (2nd) part of duodenum.
2. body of gall bladder.
3. bile duct.
4. superior (1st) part of duodenum.

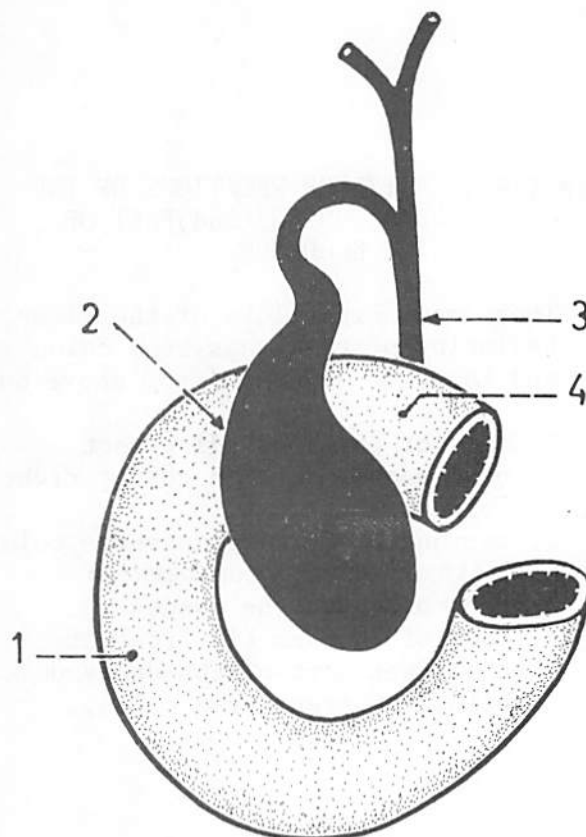


Fig.(140): POSTERIOR RELATIONS OF SUPERIOR PART OF DUODENUM

These are the portal vein, bile duct and gastroduodenal artery.

1. bile duct.
2. gastro-duodenal artery (a branch of the common hepatic artery).
3. superior part of duodenum.
4. superior pancreaticoduodenal artery (one of the terminal divisions of the gastro-duodenal artery).
5. head of pancreas.
6. portal vein.
7. common hepatic artery.

* Note that the bile duct behind the superior part of the duodenum is accompanied by the gastroduodenal artery, while above the duodenum the duct is accompanied by the hepatic artery proper (the continuation of the common hepatic artery).

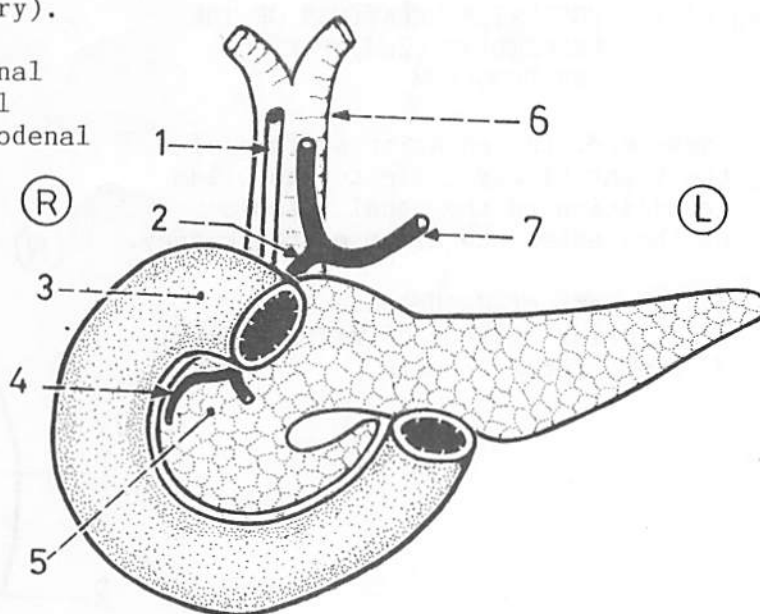


Fig.(141): ANTERIOR RELATIONS OF THE
DESCENDING (2nd)PART OF
THE DUODENUM

These are: right lobe of the liver,
beginning of the transverse colon
and loops of jejunum. (from above downwards).

1. area of the descending part
of duodenum related to the right
lobe of the liver.
2. beginning of the transverse colon
(with no peritoneum between
the colon and the duodenum).
3. loop of jejunum (in front of
the lower part of the duodenum
below the transverse colon).

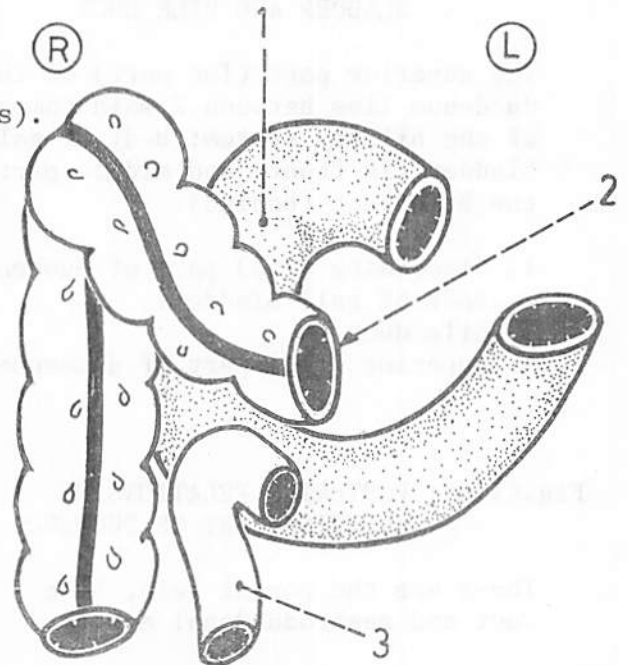
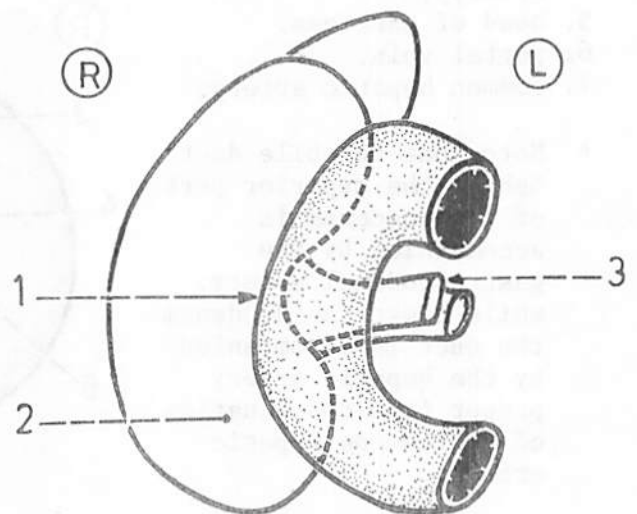


Fig.(142): POSTERIOR RELATIONS OF THE
DESCENDING (2nd) PART OF
THE DUODENUM

These are: the anterior surface of
the right kidney close to its hilum
in addition to the renal vessels
as they enter the hilum of the kidney.

1. 2nd part of duodenum.
2. anterior surface of right kidney.
3. right renal vessels.



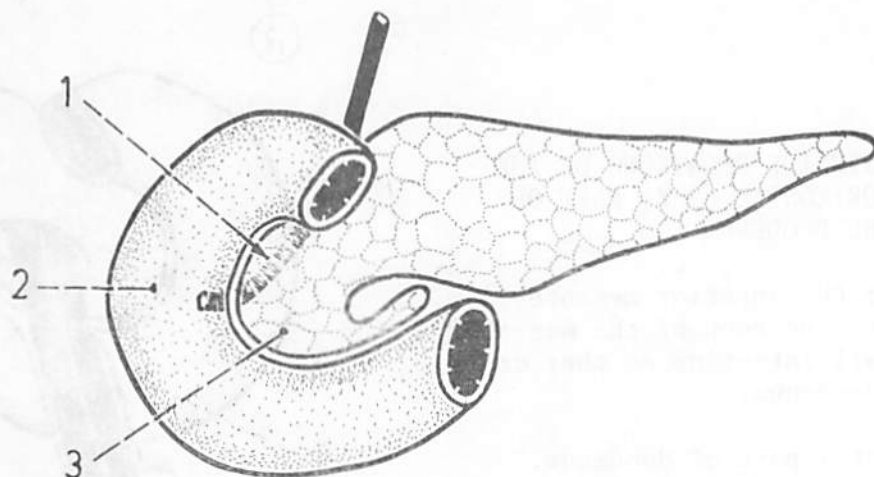


Fig.(143): MEDIAL RELATIONS OF THE DESCENDING PART OF THE DUODENUM

These are: the head of pancreas and lower part of the bile duct.

1. lower part of the bile duct; 2. descending part of the duodenum;
3. head of pancreas.

Fig.(144): DUCTS OPENING INTO THE DESCENDING PART OF DUODENUM

These are: bile duct, main pancreatic duct and accessory pancreatic duct.

The bile duct and main pancreatic duct enter the middle of the medial wall of the descending part of the duodenum where they unite to form a dilated part called hepato-pancreatic ampulla. This ampulla opens on the summit of the major duodenal papilla. The accessory pancreatic duct opens separately about 2 cm above (proximal to) the major papilla.

1. bile duct.
2. opening of accessory pancreatic duct.
3. major duodenal papilla.
4. main pancreatic duct (unites with the bile duct in the wall of the duodenum).
5. accessory pancreatic duct.

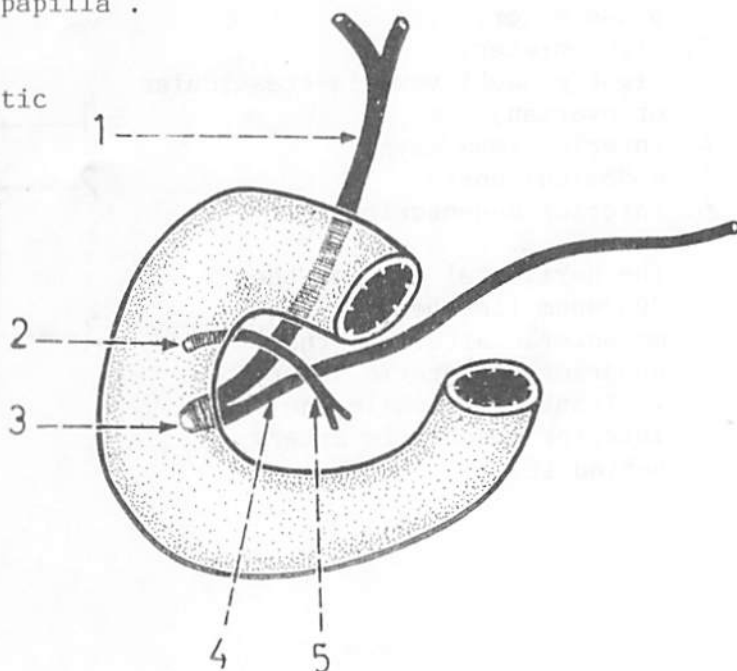


Fig.(145): ANTERIOR RELATIONS OF THE HORIZONTAL (3rd) PART OF THE DUODENUM

These are: the superior mesenteric vessels and the root of the mesentery of the small intestine as they cross over the duodenum.

1. horizontal part of duodenum.
2. root of mesentery of the small intestine.
3. superior mesenteric vein.
4. superior mesenteric artery.

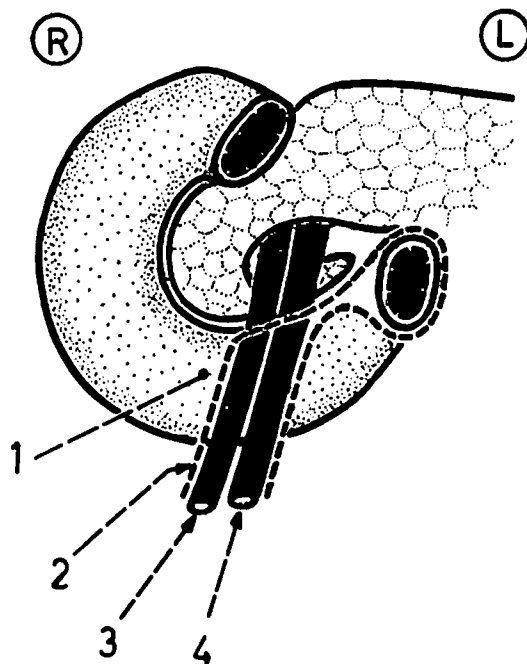


Fig.(146): POSTERIOR RELATIONS OF THE HORIZONTAL (3rd) PART OF THE DUODENUM

These are: right psoas major, right ureter, right gonadal vessels, inferior vena cava, abdominal aorta and origin of inferior mesenteric artery.

1. psoas major.
2. right ureter.
3. right gonadal vessels (testicular or ovarian).
4. inferior vena cava.
5. abdominal aorta.
6. inferior mesenteric artery.

* The horizontal part of the duodenum lies between the 2 mesenteric arteries: the superior mesenteric artery in front of it, while the inferior mesenteric artery behind it.

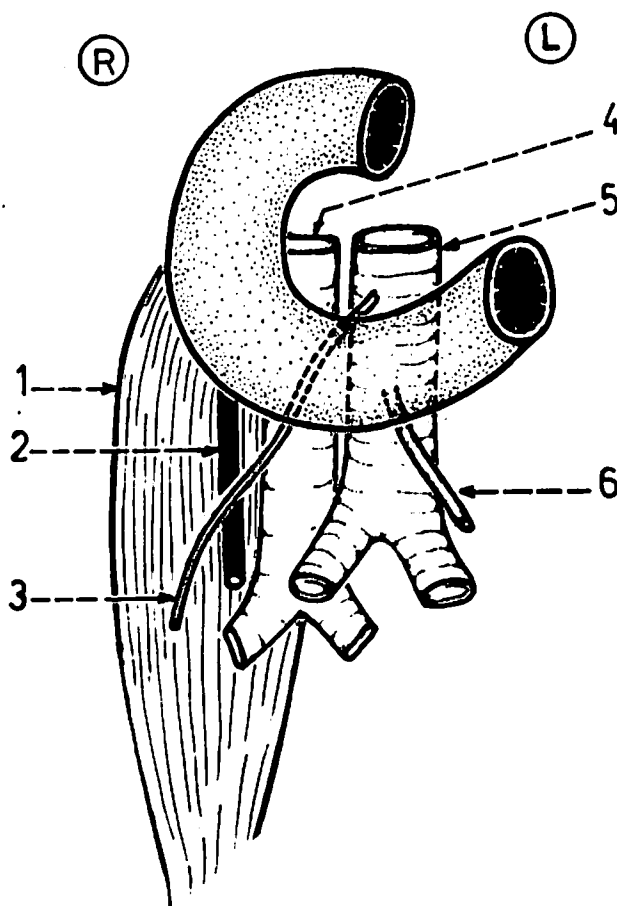


Fig.(147): POSTERIOR RELATIONS OF THE ASCENDING (4th) PART OF THE DUODENUM

These are: left psoas major, left sympathetic trunk, left renal vessels, left gonadal artery (testicular or ovarian) and inferior mesenteric vein.

1. abdominal aorta.
2. left sympathetic trunk.
3. inferior mesenteric vein.
4. left renal vessels.
5. ascending part of duodenum.
6. left gonadal artery.

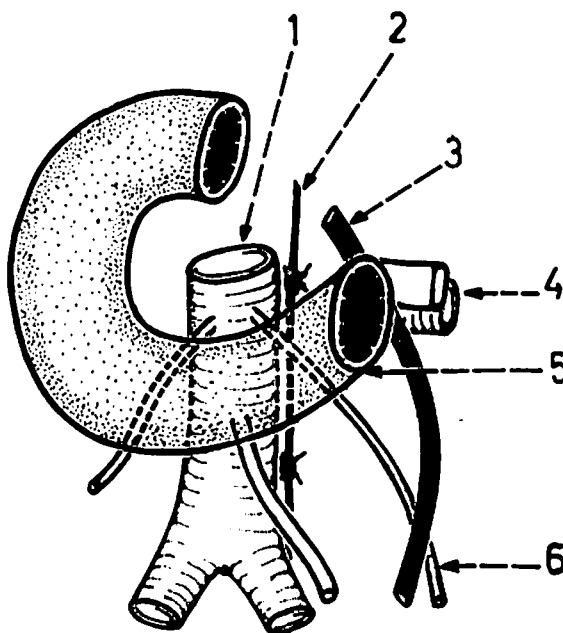


Fig.(148): SUSPENSORY MUSCLE OF THE DUODENUM

This is a fibromuscular band which extends upwards and to the right from the terminal part of the duodenum and the duodeno-jejunal flexure to the right crus of the diaphragm.

1. transverse colon (reflected upwards).
2. transverse mesocolon (reflected upwards).
3. bare area of duodenum (it is the area devoid of peritoneal covering where the descending part of the duodenum comes in direct contact with the beginning of the transverse colon).
4. line of attachment of the transverse mesocolon (it crosses horizontally just above the termination of the duodenum).
5. suspensory ligament of duodenum (passes upwards and to the right to reach the right crus).
6. termination of the duodenum (where the jejunum begins to form the jejunal flexure).

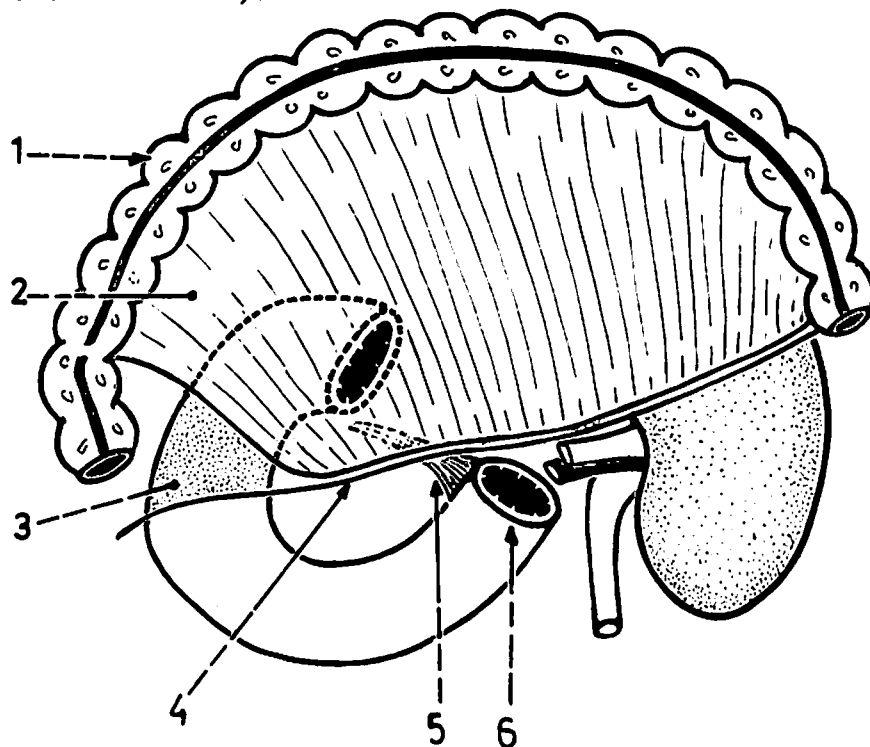


Fig.(149): ARTERIES OF THE DUODENUM

The duodenum gets its arterial supply from the following arteries: right gastric, right gastro-epiploic, superior pancreaticoduodenal and supraduodenal (from the hepatic), as well as the inferior pancreaticoduodenal (from the superior mesenteric).

1. right gastric artery.
2. hepatic artery.
3. supraduodenal artery.
4. gastro-duodenal artery.
5. superior pancreaticoduodenal artery.
6. inferior pancreaticoduodenal artery.
7. superior mesenteric artery.
8. right gastro-epiploic artery.

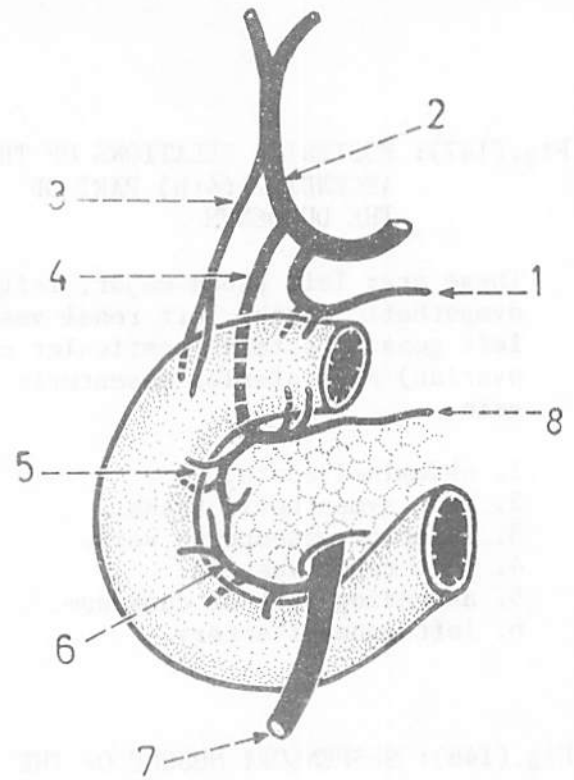
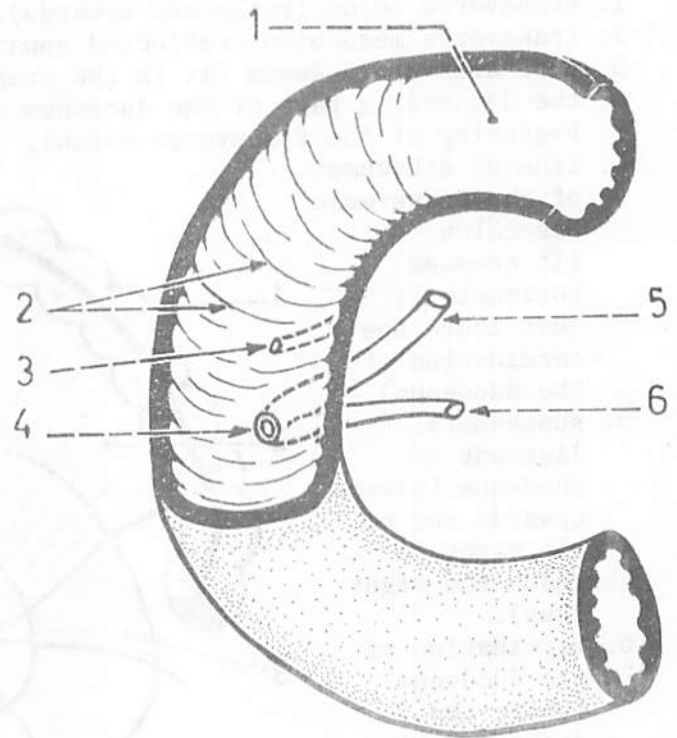


Fig.(150): CIRCULAR FOLDS OF THE MUCOUS MEMBRANE OF THE DUODENUM

These are transverse folds of mucous membrane which project into the lumen of the small intestine as a whole. However, they are absent from the 1st 1-2 inches of the duodenum (its 1st part), but they are very large and dense beyond the middle of the 2nd part of the duodenum.

1. area devoid of circular folds.
2. circular folds (plicae circulares).
3. minor duodenal papilla.
4. major duodenal papilla.
5. bile duct.
6. main pancreatic duct.



JEJUNUM AND ILEUM

Fig.(151): MESENTERY OF THE SMALL INTESTINE

It is an extensive fold of peritoneum which is highly folded and suspends the jejunum and ileum to the posterior abdominal wall. It has an attached border (or root of the mesentery) which is attached to the lower part of the posterior abdominal wall in the infracolic compartment of the greater sac, and a free border which encloses the loops of jejunum and ileum.

1. attached border (root of mesentery).
2. mesentery of the small intestine.
3. intestinal loops in the free border of the mesentery.

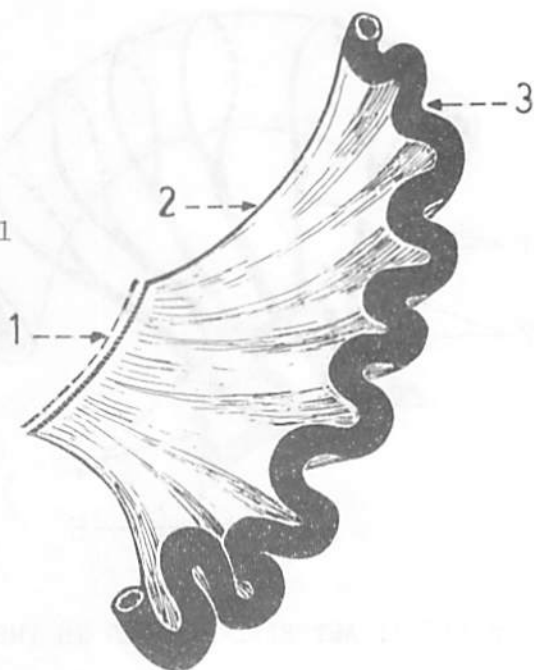
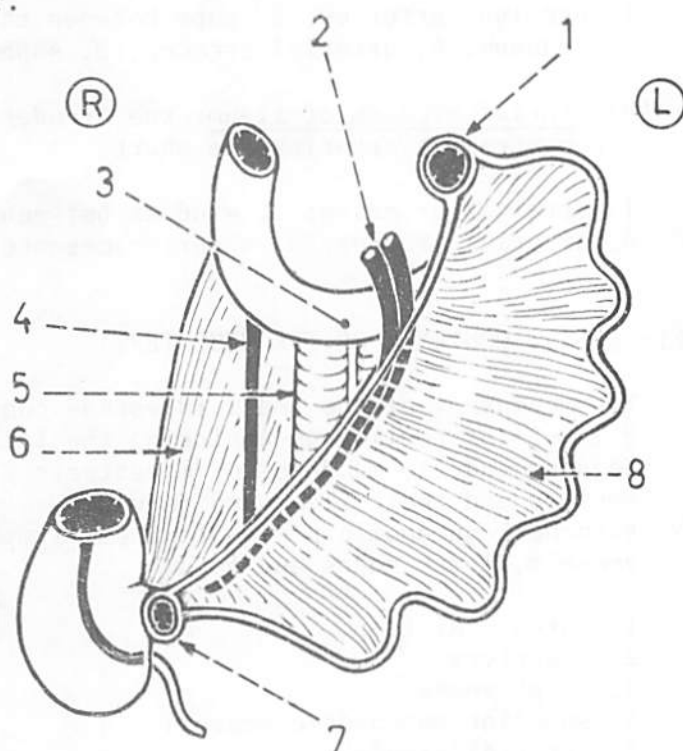


Fig.(152): COURSE AND RELATIONS OF THE ROOT OF THE MESENTERY

The mesentery of the small intestine lies in the infracolic compartment below the transverse mesocolon. Its root is attached to the posterior abdominal wall along an oblique line extending downwards and to the right from the duodeno-jejunal flexure to the ileo-caecal junction. It crosses on the following structures in succession (from left to right): horizontal part of duodenum and related superior mesenteric vessels, abdominal aorta, inferior vena cava, right ureter and right psoas major.

1. duodeno-jejunal flexure.
2. superior mesenteric vessels.
3. horizontal part of duodenum.
4. right ureter.
5. inferior vena cava (along the right side of the aorta).
6. right psoas major.
7. ileo-caecal junction.
8. mesentery of the small intestine (the intestinal loops are removed).



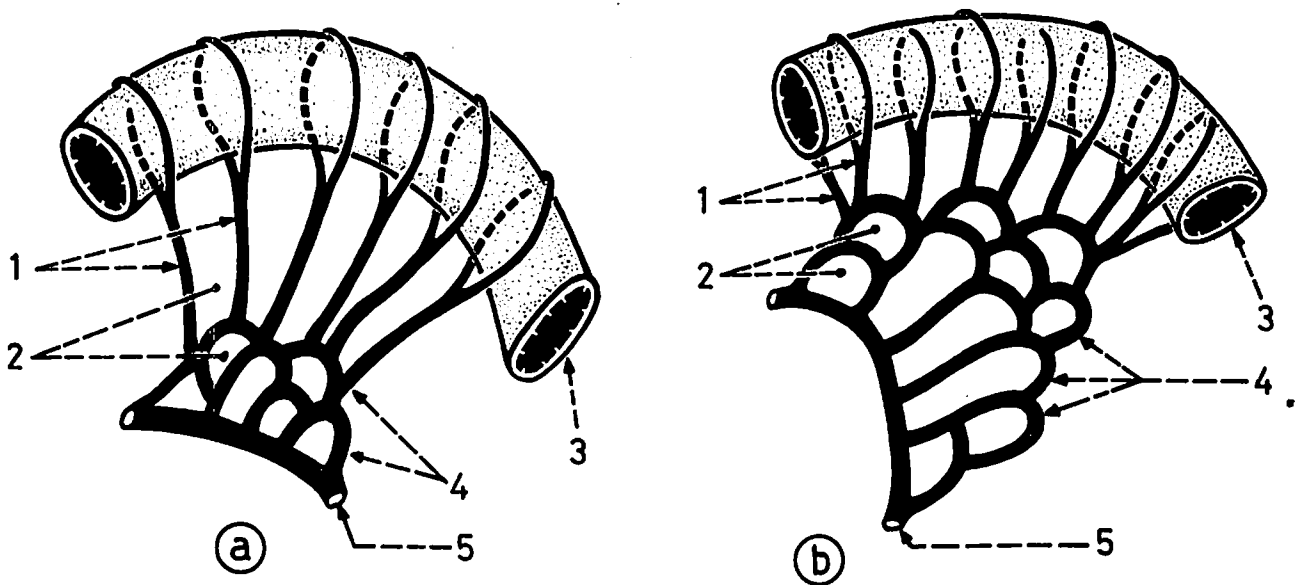


Fig.(153): ARTERIAL ARCADES IN THE MESENTERY OF SMALL INTESTINE

The jejunum and ileum get their blood supply from a series of jejunal and ileal branches which arise from the superior mesenteric artery. These branches enter the mesentery where they branch repeatedly forming a series of arcades. From the most peripheral arcades straight arteries (vasa rectae) arise and pass directly to the intestine without anastomosing.

(a) Arterial arcades of jejunum: the arcades are few in number and the straight arteries are long.

1. straight arteries; 2. gaps between the arteries (windows); 3. loop of jejunum; 4. arterial arcades; 5. superior mesenteric artery.

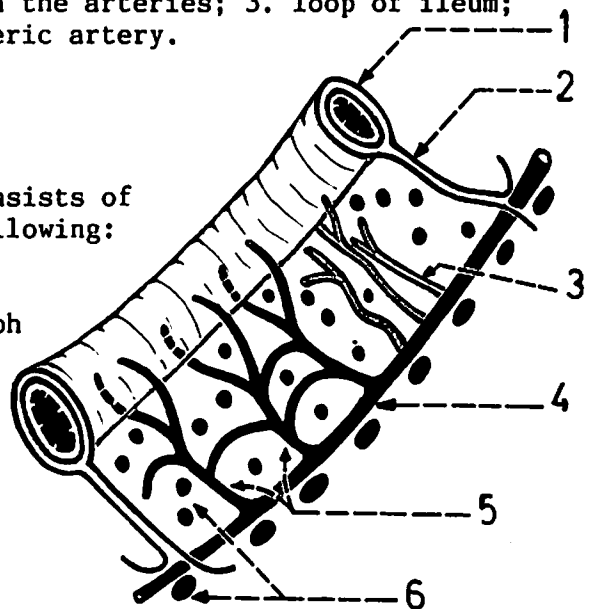
(b) Arterial arcades of ileum: the arcades are numerous and complicated and the straight arteries are short.

1. straight arteries; 2. windows between the arteries; 3. loop of ileum; 4. arterial arcades; 5. superior mesenteric artery.

Fig.(154): CONTENTS OF THE MESENTERY

The mesentery of the small intestine consists of 2 layers of peritoneum enclosing the following: jejunum and ileum, superior mesenteric vessels and their ileal and jejunal branches, autonomic nerve plexuses, lymph vessels, lymph nodes and fat.

1. intestinal loop.
2. mesentery.
3. lymph vessel.
4. superior mesenteric vessel.
5. arterial arcades.
6. lymph nodes.



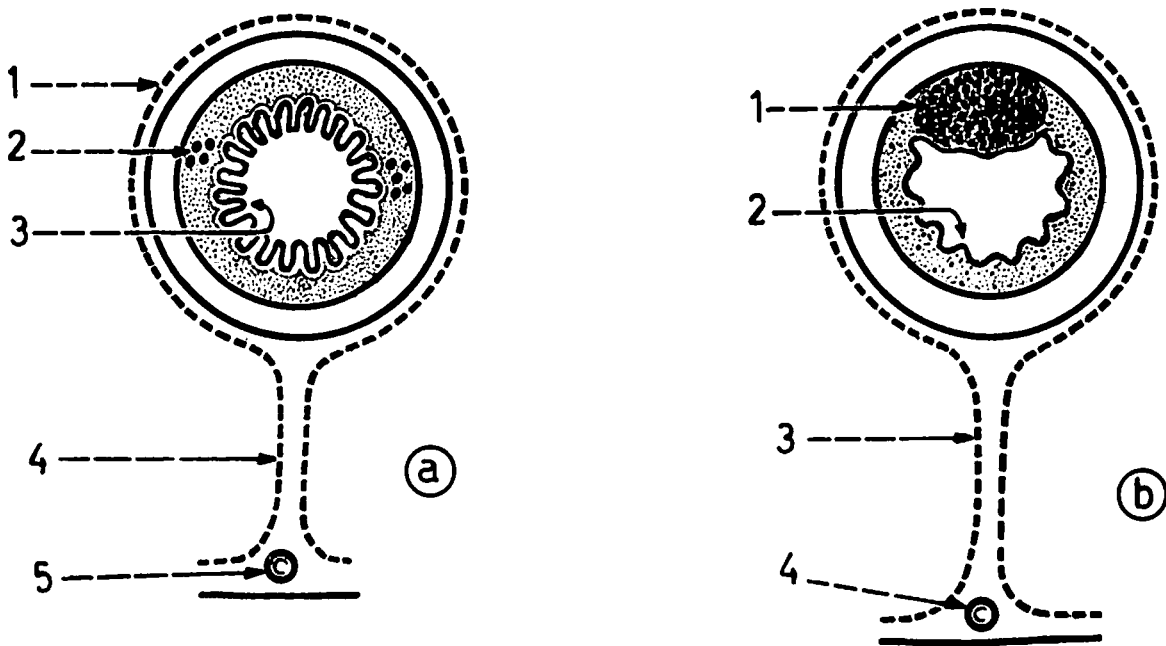


Fig.(155): MUCOUS LINING OF THE JEJUNUM AND ILEUM

(a) Jejunum: its mucosa is thicker and more vascular than that of the ileum. Its circular folds are large and thickly set and the villi are of large size. The lymphoid follicles in the submucosa are solitary and few.

1. visceral peritoneum (serosa); 2. solitary lymph node; 3. mucosa thrown into circular folds; 4. mesentery; 5. superior mesenteric artery.

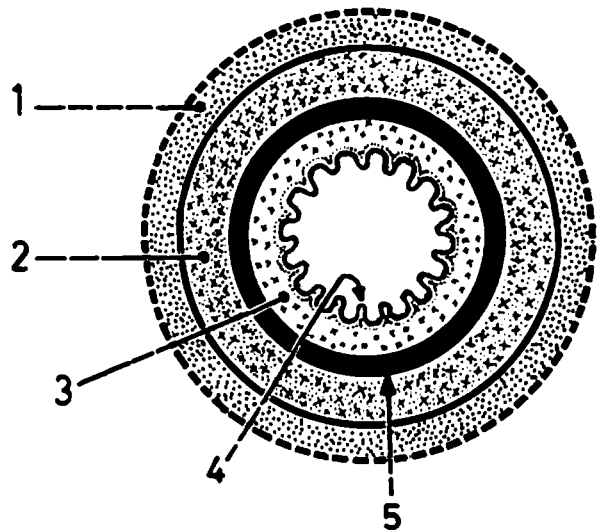
(b) Ileum: its mucosa is thinner and less vascular than that of the jejunum. Its circular folds are few in number and disappear completely in its lower part. Its lymphoid follicles are more numerous than in the jejunum and are aggregated into larger masses called Peyer's patches. These patches are placed lengthwise at the anti-mesenteric border of the ileum.

1. Peyer's patch; 2. mucosa; 3. mesentery; 4. superior mesenteric artery.

Fig.(156): AUTONOMIC NERVE PLEXUSES IN THE WALL OF THE INTESTINE

In the wall of the intestine the autonomic nerves form 2 plexuses: Myenteric plexus (between the circular and longitudinal muscle layers) and submucous plexus (in the submucosa).

1. outer longitudinal muscle layer.
2. myenteric plexus.
3. submucous plexus.
4. mucosa.
5. inner circular muscle layer.



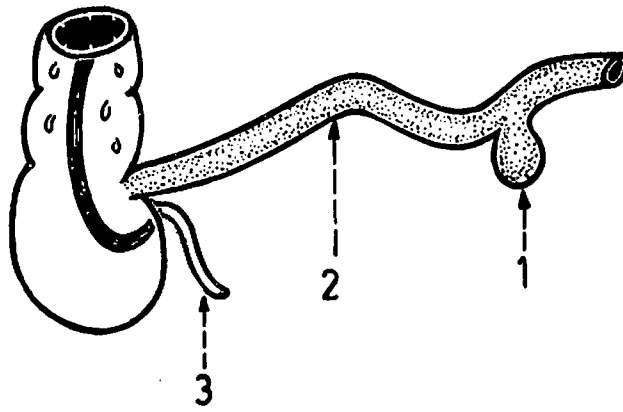


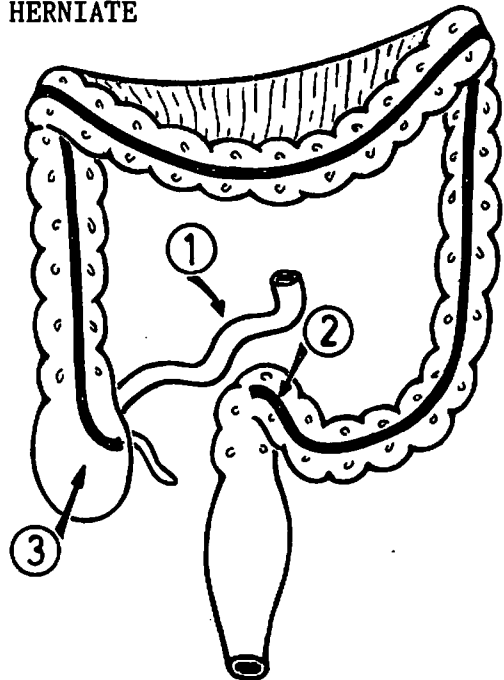
Fig.(157): MECKEL'S DIVERTICULUM

It is a small pouch (2 inches long) which projects from the lower part of the ileum about 2 feet from the ileo-caecal junction. It is a rare finding which is present in 2% of subjects. It has the same diameter as that of the ileum and its mucosa may abnormally contain gastric glands.

1. Meckel's diverticulum.
2. terminal part of ileum.
3. vermiform appendix.

Fig.(158): PARTS OF INTESTINE WHICH COMMONLY HERNIATE

1. loops of ileum.
2. sigmoid colon.
3. caecum.



LARGE INTESTINE

Fig.(159): POSITION AND PARTS OF THE LARGE INTESTINE

The large intestine begins in the right iliac fossa by the caecum (most dilated part), ascends in the right side of the abdominal cavity as the ascending colon, runs transversely to the left side as the transverse colon, descends in the left side of the abdominal cavity as the descending colon, enters the pelvic cavity where it forms the sigmoid colon and ends by the formation of the rectum and anal canal. The large intestine forms a large curve in the periphery of the abdominal cavity having the small intestine in its concavity.

1. right colic flexure (in front of right kidney).
2. ascending colon.
3. caecum with the vermiform appendix.
4. sigmoid colon (S-shaped).
5. descending colon.
6. left colic flexure (in front of the left kidney).
7. transverse colon.

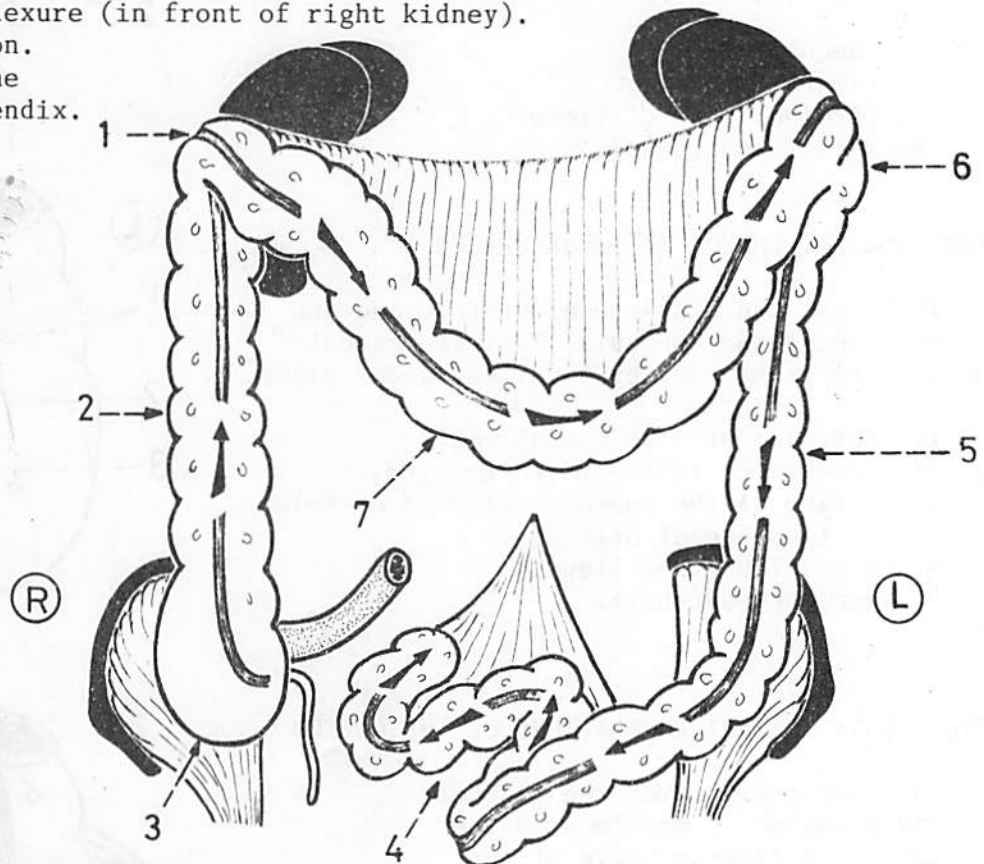
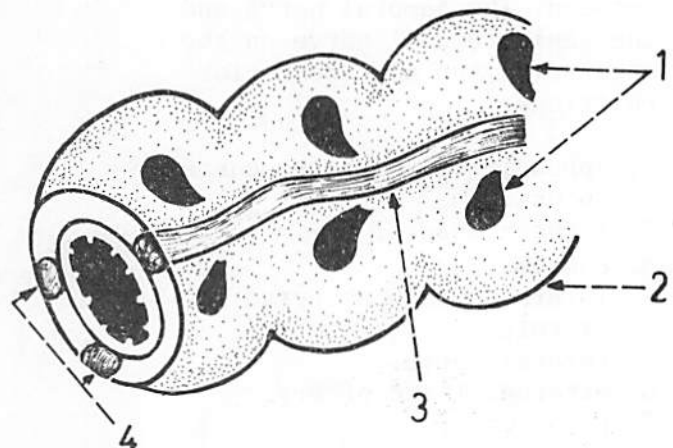


Fig.(160): CHARACTERS OF THE WALL OF THE COLON

The wall of the colon differs from that of the small intestine in having 3 taeniae coli, appendices epiploicae and sacculations.

1. appendices epiploicae.
2. sacculations.
3. taenia coli.
4. the other 2 taeniae coli (cross section).



CAECUM AND APPENDIX

Fig.(161): SURFACE ANATOMY OF THE CAECUM

It lies in the right iliac fossa where it is bounded by the right lateral plane, transtuberular plane and inguinal ligament.

- (a) transtuberular plane.
(b) right lateral plane.

1. caecum.
2. inguinal ligament.
3. terminal part of ileum.
4. vermiform appendix.

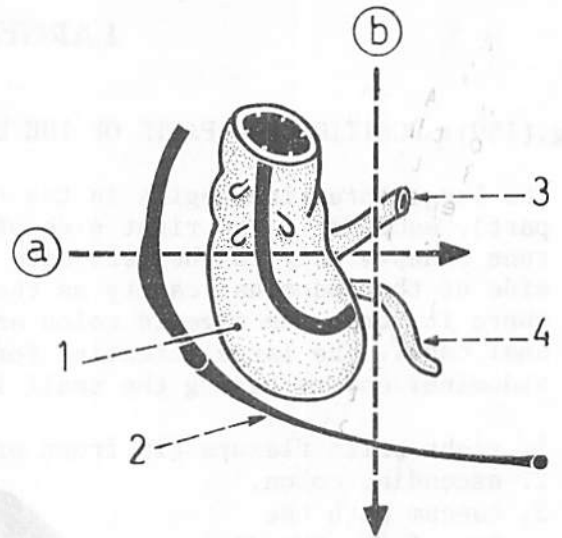


Fig.(162): OPENINGS INTO THE CAECUM

These are the ileo-caecal orifice and the orifice of the appendix. The ileo-caecal orifice is guarded by the ileo-caecal valve.

1. upper lip of ileo-caecal valve.
2. ileo-caecal (ileo-colic) orifice.
3. orifice of the appendix (lies 2 cm below the ileo-caecal orifice).
4. terminal part of ileum.
5. vermiform appendix.

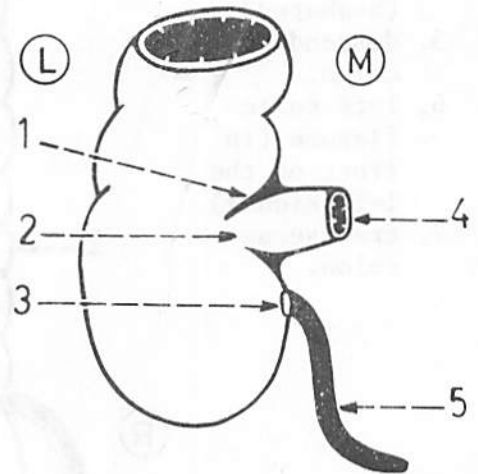
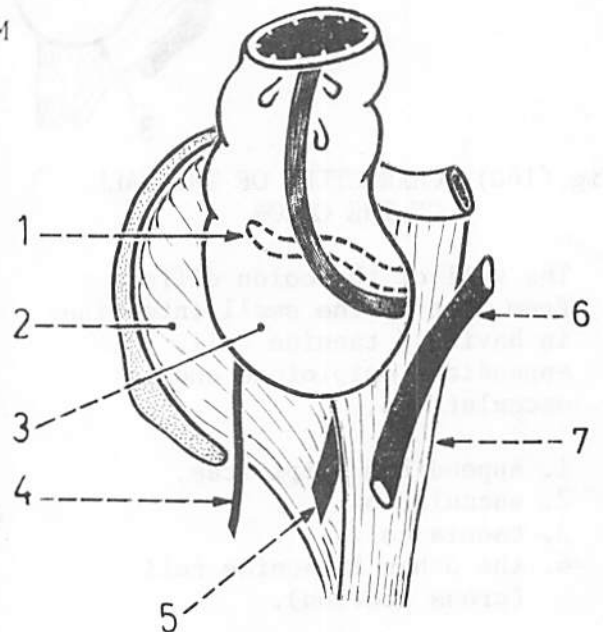


Fig.(163): POSTERIOR RELATIONS OF THE CAECUM

The caecum lies over the iliacus and psoas major muscle with the lateral cutaneous nerve of the thigh and retro-caecal recess in between. The femoral nerve and the genitofemoral nerve on the right side are also posterior relations.

1. appendix in the retro-caecal recess.
2. iliacus muscle.
3. caecum.
4. lateral cutaneous nerve of thigh.
5. femoral nerve.
6. external iliac artery.
7. psoas major.



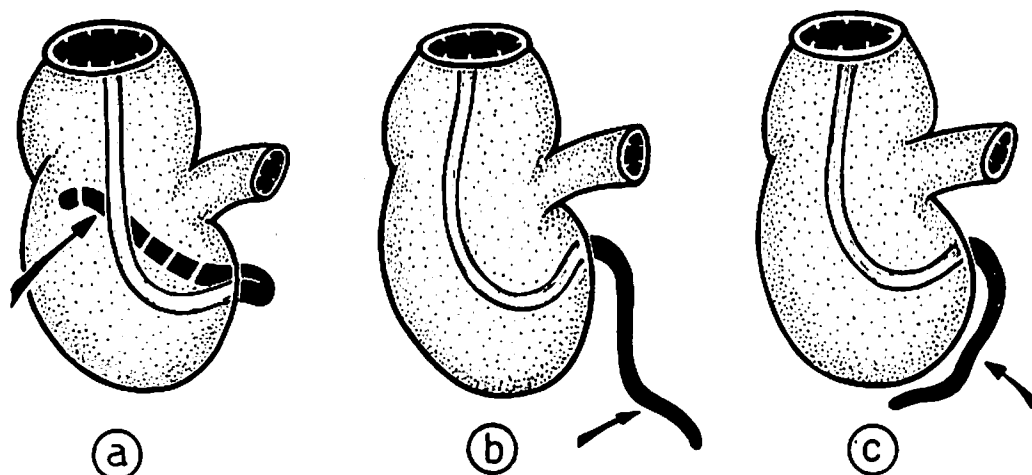


Fig.(164): POSITIONS OF THE APPENDIX

- (a) Retrocaecal position: (65%)
the appendix lies in the retrocaecal recess and may extend upwards to lie behind the ascending colon (retrocolic).
- (b) Pelvic position: (31%)
the appendix hangs down over the inlet of the lesser pelvis.
- (c) Subcaecal position: (2%)
the appendix lies in the iliac fossa just below the caecum.
- (d) Pre-ileal position: (1%)
the appendix is directed upwards in front of the terminal part of the ileum.
- (e) Post-ileal position: (1%)
the appendix is directed upwards behind the terminal part of the ileum.

* Note that the retrocaecal position is the commonest.

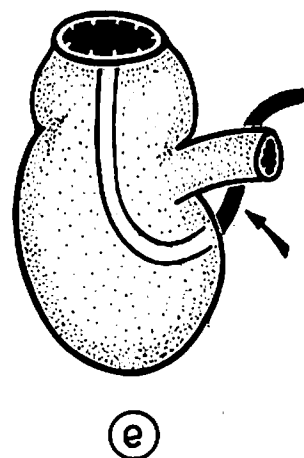
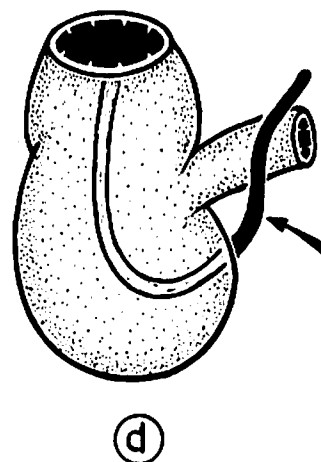


Fig.(165): SURFACE ANATOMY OF THE APPENDIX

The base of the appendix can be marked on the surface at the Mc Burney's point. This point lies at the junction of the lateral 1/3 and medial 2/3 of a line joining the right anterior superior iliac spine with the umbilicus (marked by arrow).

* Note that the base of the appendix corresponds to its orifice into the caecum.

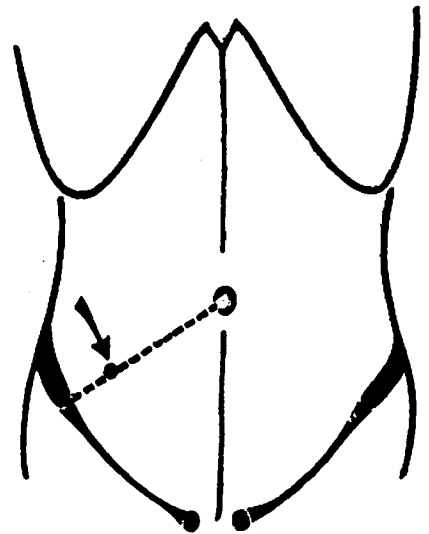


Fig.(166): RELATIONS OF THE TAENIAE COLI TO THE APPENDIX

The 3 taeniae coli run in the wall of the caecum and converge on the base of the appendix where they join together to form the longitudinal muscle coat of the appendix. The anterior taenia coli is present on the anterior surface of the caecum and is taken as a guide to the appendix at operation.

1. postero-lateral taenia coli.
2. anterior taenia coli.
3. postero-medial taenia coli.
4. base of the appendix (attached to the postero-medial surface of the caecum 1-2 cm below the ileo-caecal junction).
5. appendix.

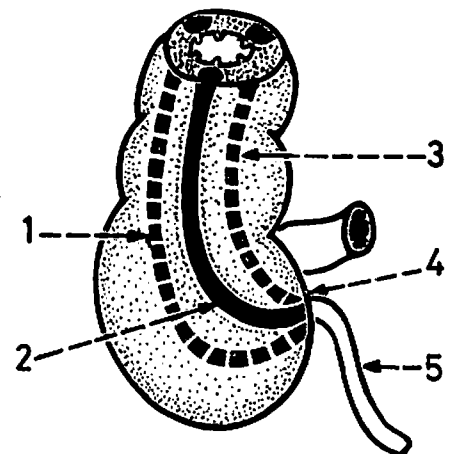


Fig.(167): LAYERS OF THE WALL OF THE APPENDIX (T.S.)

The muscle coat of the appendix may be deficient at one or 2 points so that the peritoneal covering (serosa) comes in direct contact with the submucosa; this facilitates spread of infection from the appendix to the peritoneum.

1. deficiency in the muscle wall.
2. masses of lymphoid tissue in the submucosa.
3. peritoneal covering (serosa).
4. lumen of the appendix.

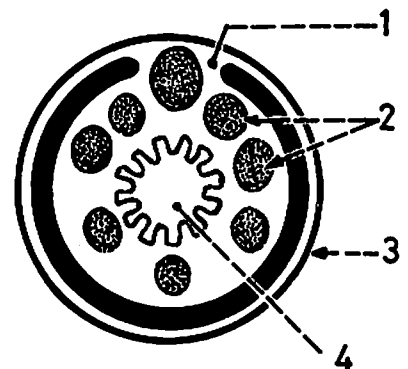


Fig.(168): MESENTERY OF THE APPENDIX

The mesentery of the appendix (mesoappendix) extends along the whole length of the appendix and has the appendicular artery running in its free border down to the tip of the appendix.

1. anterior caecal artery (to the front of the caecum).
2. posterior caecal artery (to the back of the caecum and anastomoses with the appendicular artery).
3. ileocolic artery.
4. ileocolic lymph nodes.
5. appendicular artery (passes behind the terminal part of the ileum to enter the mesoappendix).
6. terminal part of ileum.
7. one lymph node in the mesoappendix.
8. vermiform appendix.
9. mesoappendix.

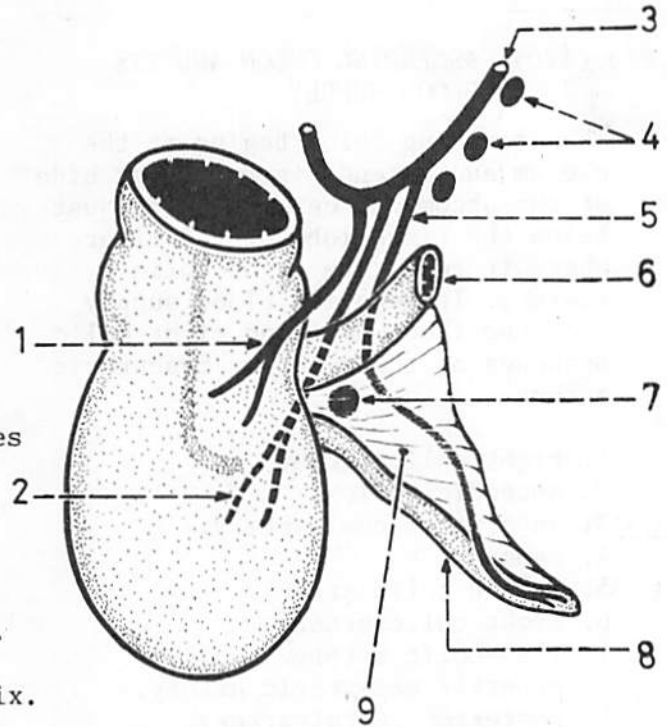
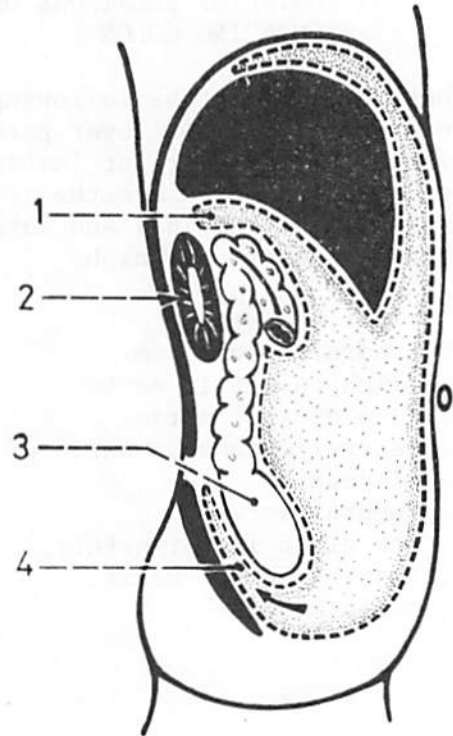


Fig.(169): RETRO-CAECAL RECESS OF PERITONEUM

The caecum is completely enveloped by peritoneum and is separated from the right iliac fossa behind by the retro-caecal recess in which the appendix usually lies.

1. hepato-renal pouch (between the right lobe of the liver and the right kidney).
2. right kidney.
3. caecum (is completely enveloped by peritoneum).
4. retro-caecal recess (behind the caecum).

* The caecum has a considerable amount of movement and thus it may herniate into the right inguinal canal.



C O L O N

Fig.(170): ASCENDING COLON AND ITS BLOOD SUPPLY

The ascending colon begins at the caecum and ascends in the right side of the abdominal cavity to end just below the right lobe of the liver where it forms the right colic flexure. It gets its blood supply from the ileo-colic and right colic branches of the superior mesenteric artery.

1. right colic flexure.
2. ascending colon.
3. anterior caecal artery.
4. caecum.
5. middle colic artery.
6. right colic artery.
7. ileo-colic artery.
8. superior mesenteric artery.
9. posterior caecal artery.
10. appendicular artery.

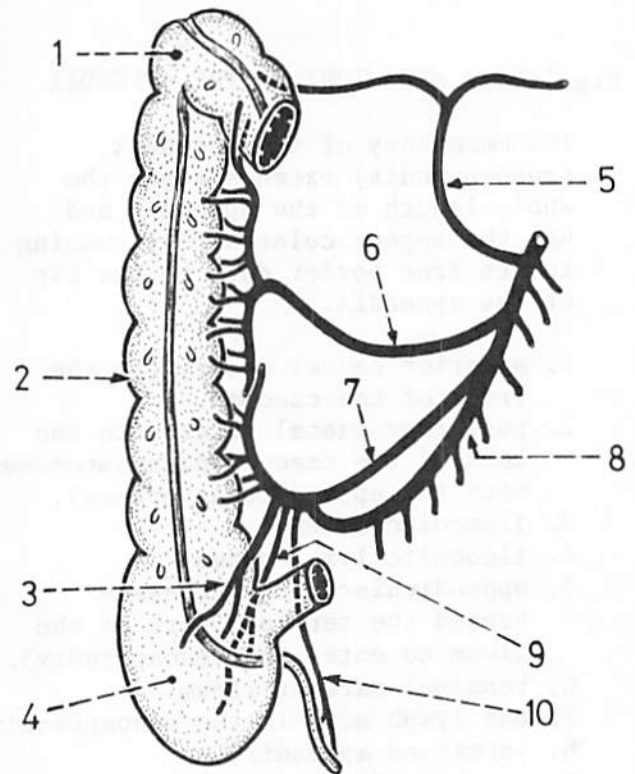


Fig.(171): POSTERIOR RELATIONS OF ASCENDING COLON

These are mainly the following: quadratus lumborum, lower part of right kidney, 4th right lumbar artery and 3 nerves which are the iliohypogastric, ilioinguinal and lateral cutaneous nerve of thigh.

1. right kidney.
2. quadratus lumborum.
3. iliohypogastric nerve.
4. ilioinguinal nerve.
5. lateral cutaneous nerve of thigh.
6. iliacus.
7. femoral nerve.
8. 4th right lumbar artery.
9. genito-femoral nerve.
10. psoas major.

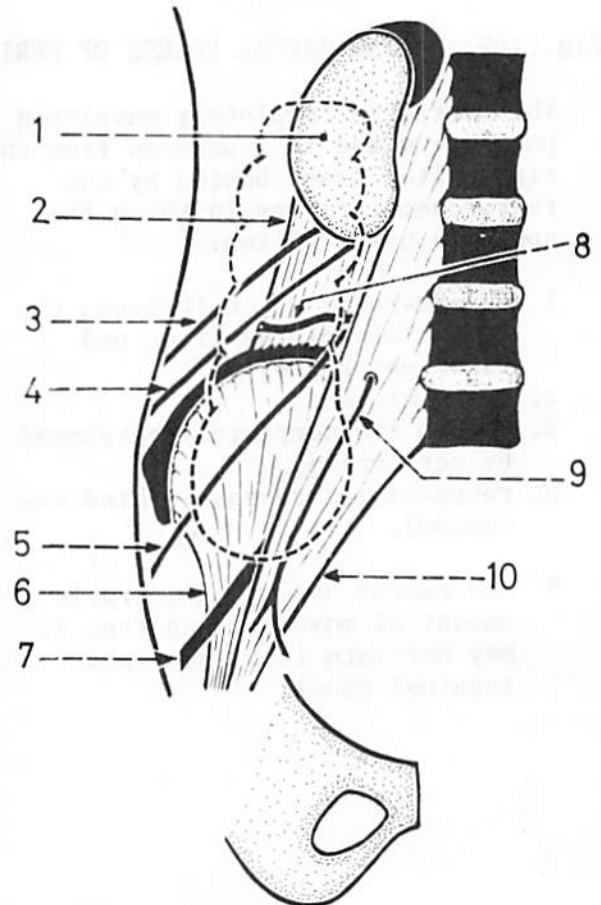


Fig.(172): RIGHT COLIC FLEXURE

It is a bend at the junction of the ascending colon and transverse colon. It lies in the right hypochondrium and is directed downwards, forwards and to the left. It lies between the right kidney behind, and the right lobe of the liver and fundus of gall bladder in front.

1. right colic flexure.
2. right kidney.
3. right lobe of liver.
4. fundus of gall bladder.

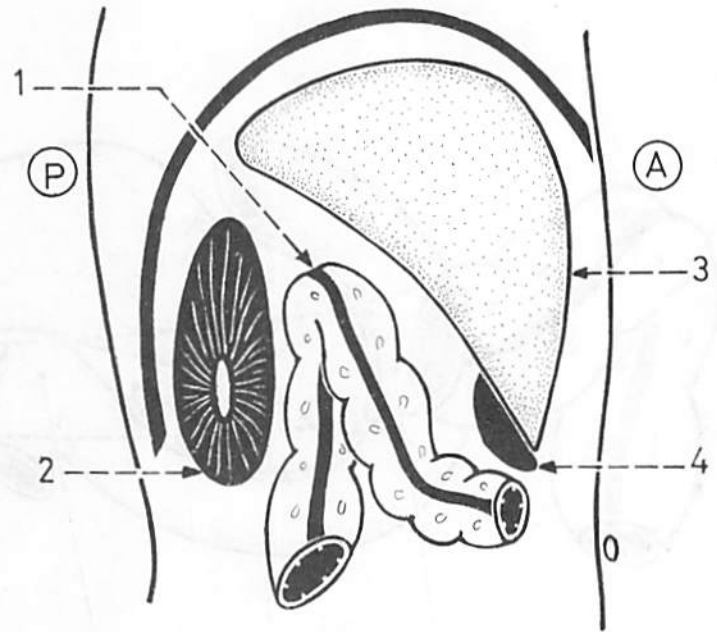
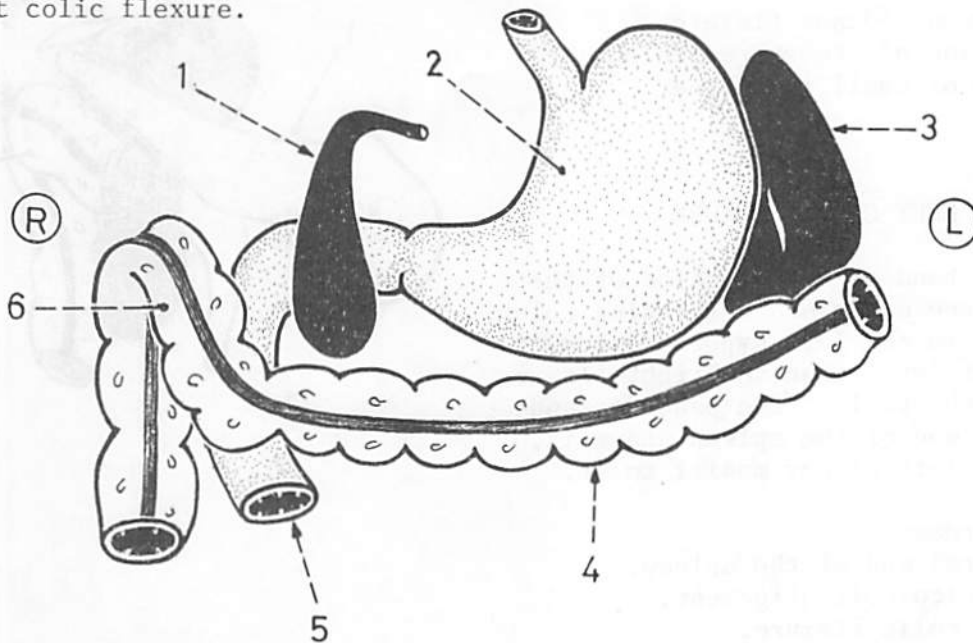


Fig.(173): STRUCTURES ABOVE THE TRANSVERSE COLON

These are: the liver, gall bladder, greater curvature of the stomach and lateral end of the spleen.

1. gall bladder.
2. stomach.
3. spleen.
4. transverse colon.
5. descending part of duodenum (crossed by the beginning of the transverse colon).
6. right colic flexure.



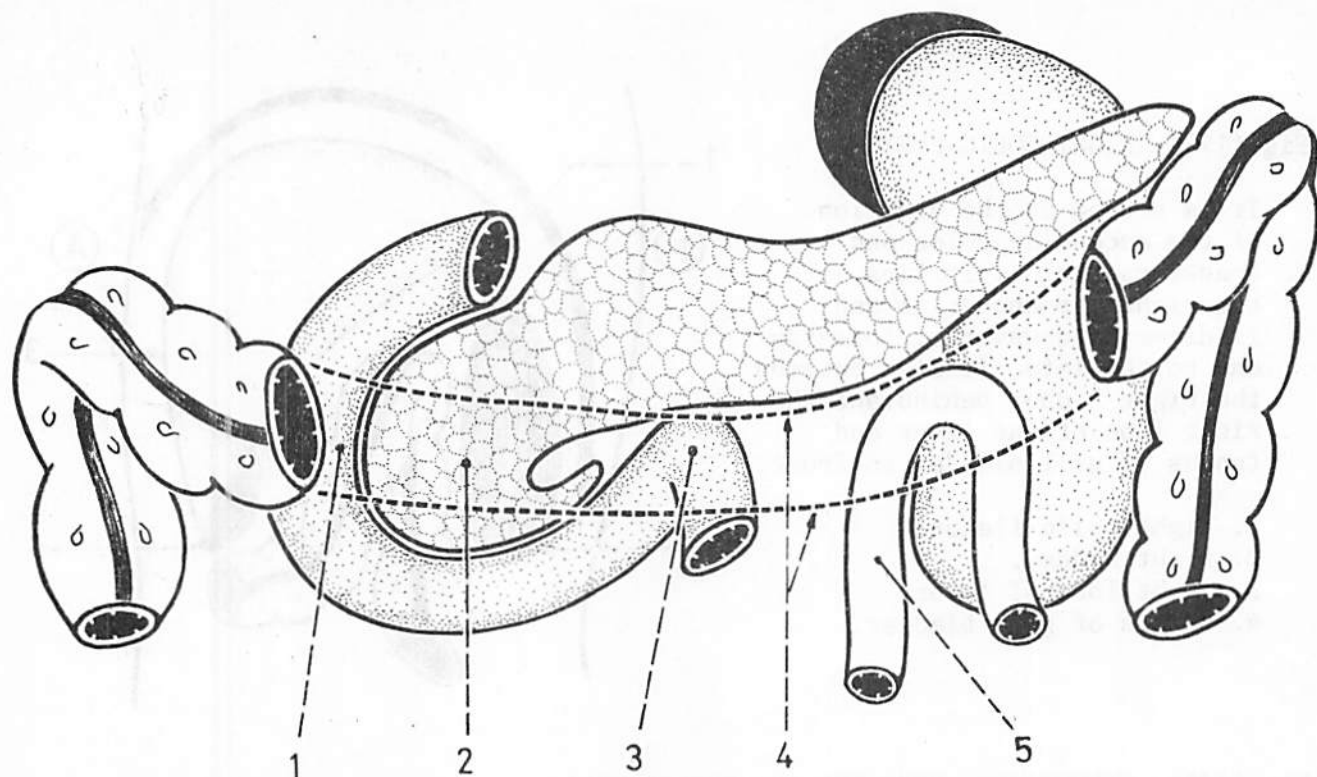


Fig.(174): STRUCTURES BEHIND THE TRANSVERSE COLON

These are: descending part of the duodenum, head of pancreas, duodeno-jejunal flexure and coils of small intestine. The transverse colon lies in direct contact with the descending part of duodenum and head of pancreas with no peritoneum in between.

1. 2nd part of duodenum.
2. head of pancreas.
3. duodeno-jejunal flexure.
4. outline of transverse colon.
5. loop of small intestine.

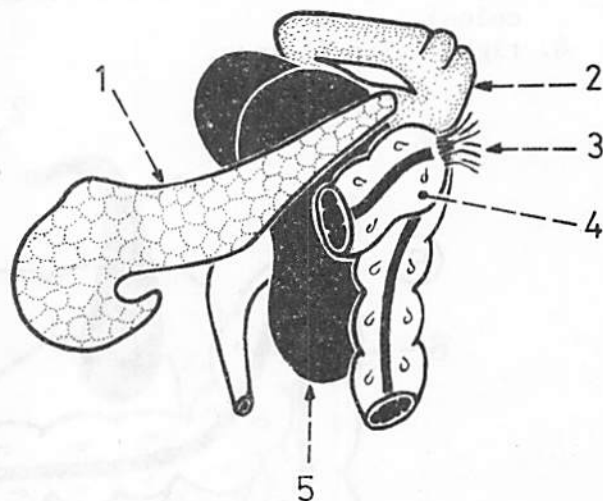


Fig.(175): LEFT COLIC FLEXURE

It is a bend at the junction of the transverse colon and descending colon. It lies in the left hypochondrium at a higher level than the right flexure. It has the tail of the pancreas and lateral end of the spleen above it, and the left kidney medial to it.

1. pancreas.
2. lateral end of the spleen.
3. phrenico-colic ligament.
4. left colic flexure.
5. left kidney.

Fig.(176): POSITION OF DESCENDING COLON

The descending colon begins in the left hypochondrium as the continuation of the left colic flexure and descends in the left side of the abdominal cavity to reach the left iliac fossa. It ends at the inlet of the lesser pelvis by becoming the sigmoid colon.

1. descending colon.
2. origin of transversus abdominis muscle.
3. quadratus lumborum muscle.
4. iliacus muscle.
5. sigmoid colon.
6. psoas major muscle.

* Note that the following structures lie behind the descending colon: lower part of left kidney and 4 muscles (origin of transversus abdominis, quadratus lumborum, iliacus, psoas major).

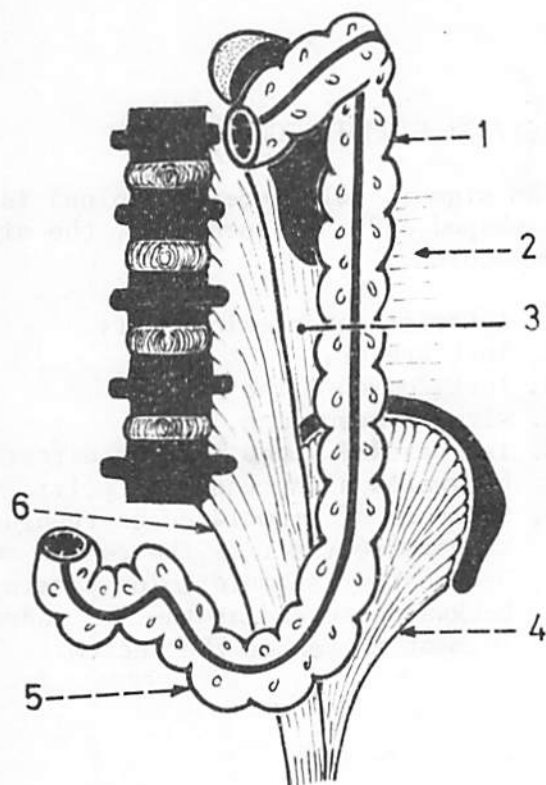


Fig.(177): STRUCTURES CROSSING BEHIND THE DESCENDING COLON

The following structures cross behind the descending colon: subcostal nerve and vessels, gonadal vessels, ilio-hypogastric nerve, ilio-inguinal nerve, lateral cutaneous nerve of thigh, femoral nerve and genitofemoral nerve.

1. subcostal nerve.
2. ilio-hypogastric nerve.
3. ilio-inguinal nerve.
4. lateral cutaneous nerve of thigh.
5. left gonadal vessels.
6. femoral nerve.
7. genitofemoral nerve.

* The above structures cross between the descending colon and its muscle bed formed by the following 4 muscles: quadratus lumborum, origin of transversus abdominis, iliacus and psoas major.

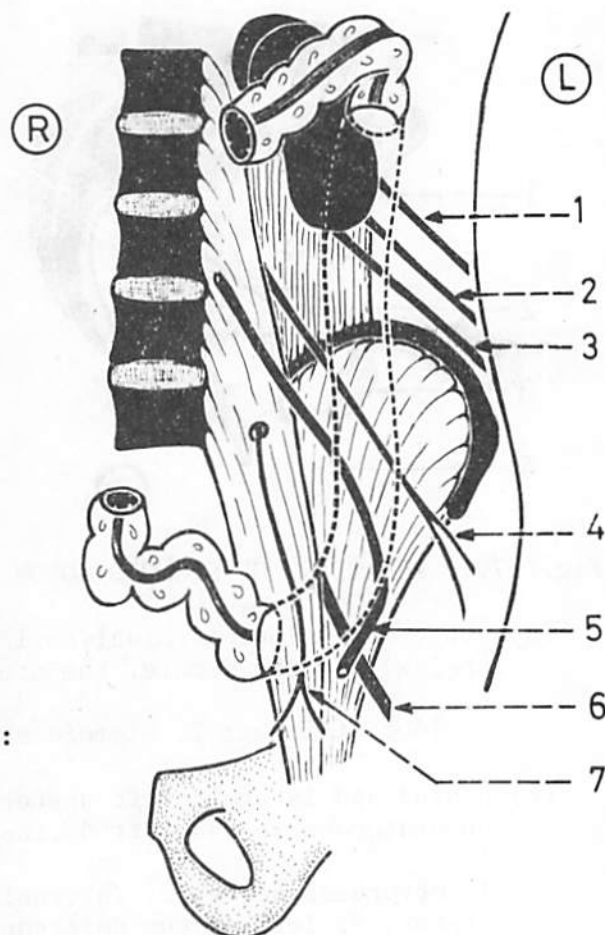


Fig. (178): SIGMOID COLON

The sigmoid colon (pelvic colon) is S-shaped and is suspended by the sigmoid mesocolon.

1. inferior mesenteric artery.
2. left ureter.
3. left common iliac artery.
4. sigmoid mesocolon.
5. 1st part of sigmoid colon directed backwards along the left pelvic wall.
6. 2nd part of sigmoid colon running transversely across the pelvic cavity.
7. 3rd part of sigmoid colon passing backwards to end at the 3rd sacral segment to become the rectum.

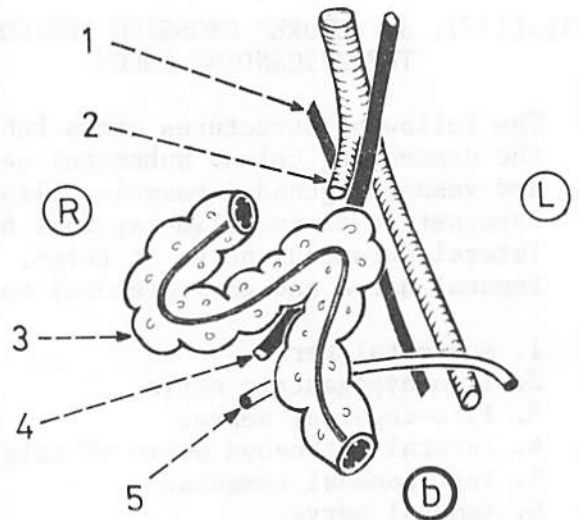
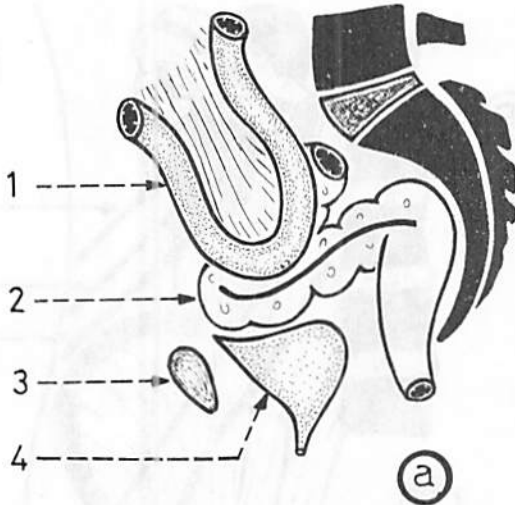
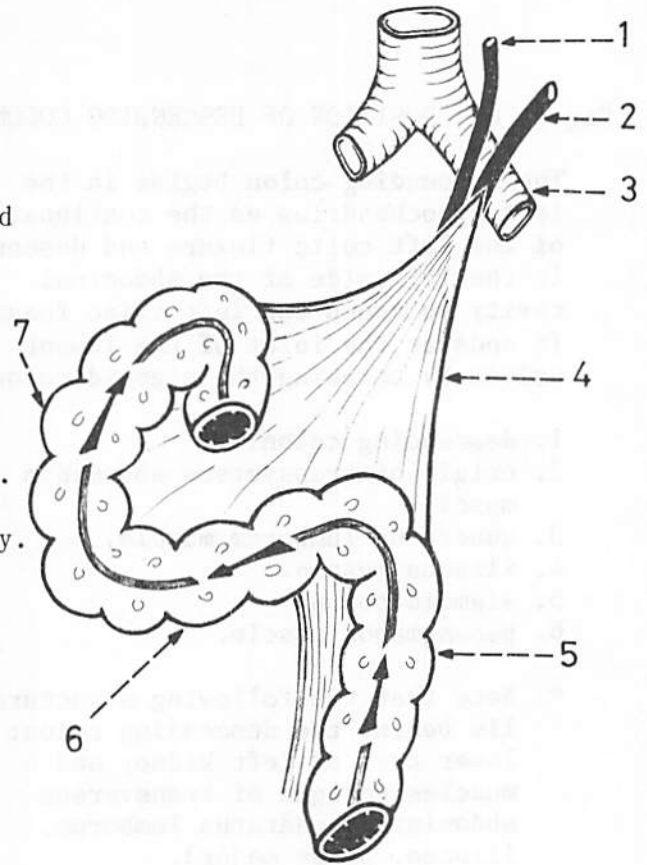


Fig.(179): RELATIONS OF SIGMOID COLON

- (a) above and below: terminal coils of ileum (above) and urinary bladder (below). In the female, the uterus is an inferior relation.

1. loop of ileum; 2. sigmoid colon; 3. symphysis pubis; 4. urinary bladder.

- (b) behind and lateral: left ureter and internal iliac vessels (behind), and obturator nerve and left ductus deferens or left ovary (lateral).

1. obturator nerve; 2. internal iliac artery; 3. sigmoid colon; 4. left ureter; 5. left ductus deferens.

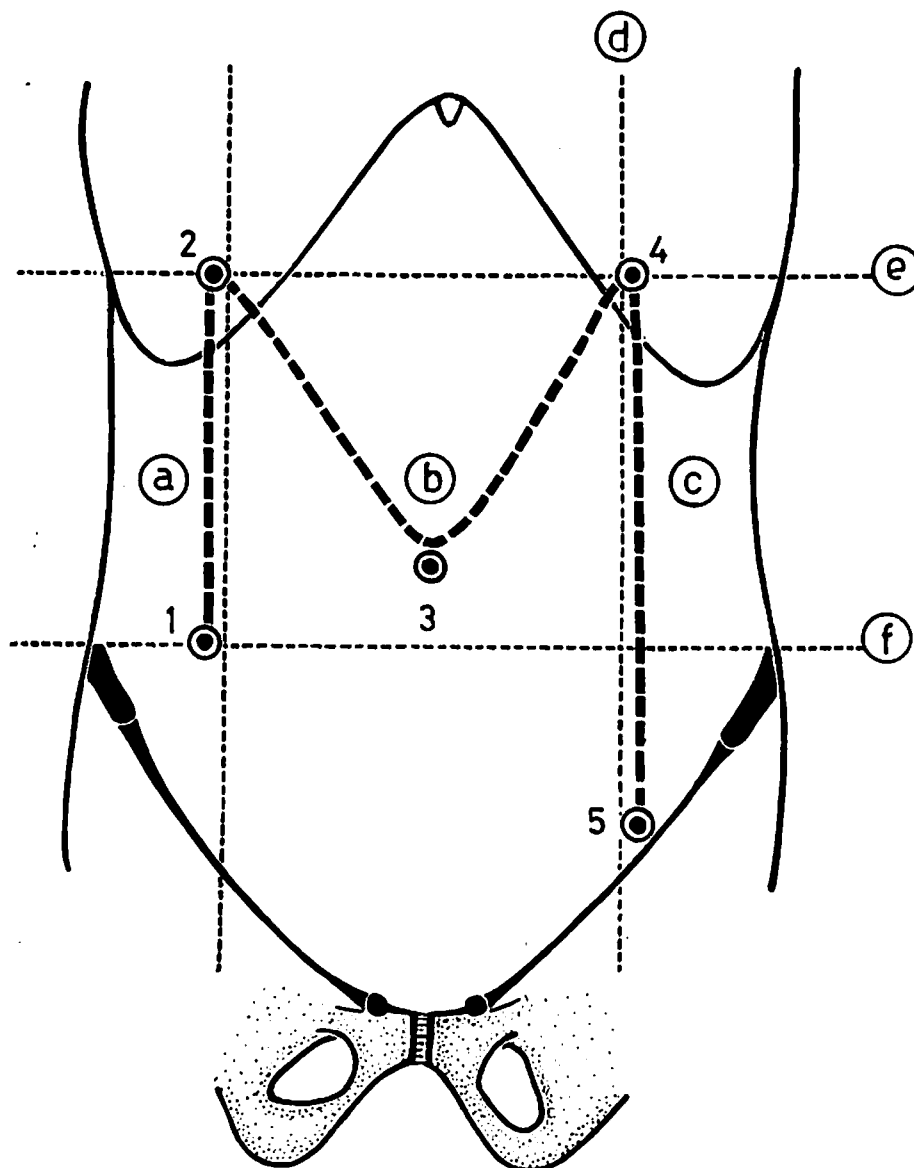


Fig.(180): SURFACE ANATOMY OF DIFFERENT PARTS OF THE COLON

- (a) Ascending colon: It is represented by a vertical line drawn just to the right of and parallel to the right lateral plane, and extending from the transtuberular plane (point 1) to the transpyloric plane (point 2).
- (b) Transverse colon: It is represented by a curved line with its concavity upwards extending from point (2) on the transpyloric plane to point (3) at the umbilicus and then upwards to point (4) on the transpyloric plane just to the left of the left lateral plane.
- (c) Descending colon: It is represented by a vertical line drawn just to the left of and parallel to the left lateral plane and extending from the transpyloric plane (point 4) to the inguinal ligament (point 5).
- (d) Left lateral plane.
- (e) Transpyloric plane.
- (f) Transtuberular plane.

Fig.(181): ARTERIAL SUPPLY OF THE DESCENDING COLON AND SIGMOID COLON

These 2 parts of the colon get their blood supply from the inferior mesenteric artery.

1. inferior mesenteric artery.
2. superior rectal artery (the continuation of the inferior mesenteric artery to the rectum).
3. left colic branch (to the descending colon, left colic flexure and left part of the transverse colon).
4. sigmoid branches (to the sigmoid colon and lower part of the descending colon).
5. lower part of descending colon.
6. sigmoid colon.

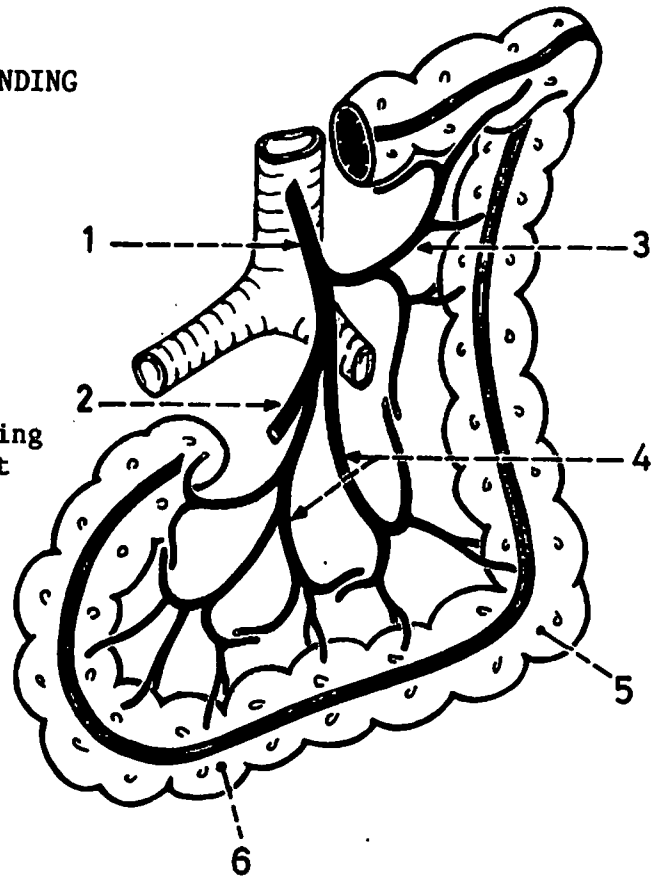


Fig.(182): DISTRIBUTION OF ARTERIES TO THE LARGE INTESTINE

- (a) Parts of large intestine supplied by superior mesenteric artery: these are the caecum, appendix, ascending colon, right colic flexure and right 2/3 of the transverse colon.
- (b) Parts supplied by inferior mesenteric artery: these are the left 1/3 of transverse colon, left colic flexure, descending colon, sigmoid colon, rectum and upper 1/2 of the anal canal.

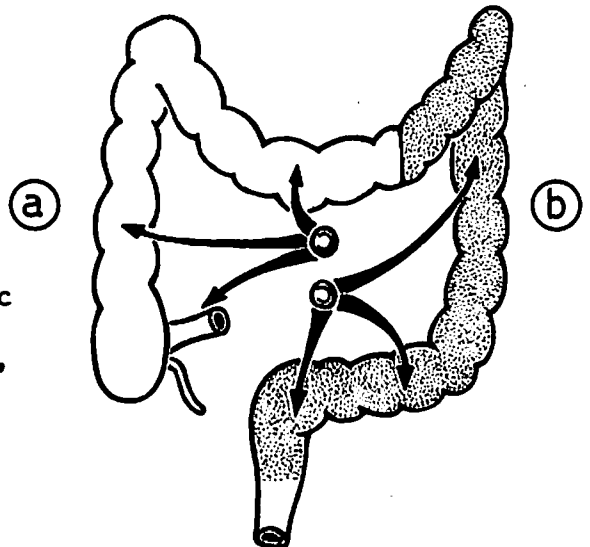


Fig.(183): VENOUS DRAINAGE OF
LARGE INTESTINE

The whole large intestine except the lower 1/2 of the anal canal is drained into the portal circulation through the superior and inferior mesenteric veins.

1. superior mesenteric vein
(drains the appendix, caecum, ascending colon, right colic flexure and right 2/3 of the transverse colon).
2. portal vein.
3. splenic vein.
4. inferior mesenteric vein
(drains the left 1/3 of the transverse colon, left colic flexure, descending colon, sigmoid colon, rectum and upper 1/2 of the anal canal).

* This distribution of venous drainage is the same as that of the arterial supply.

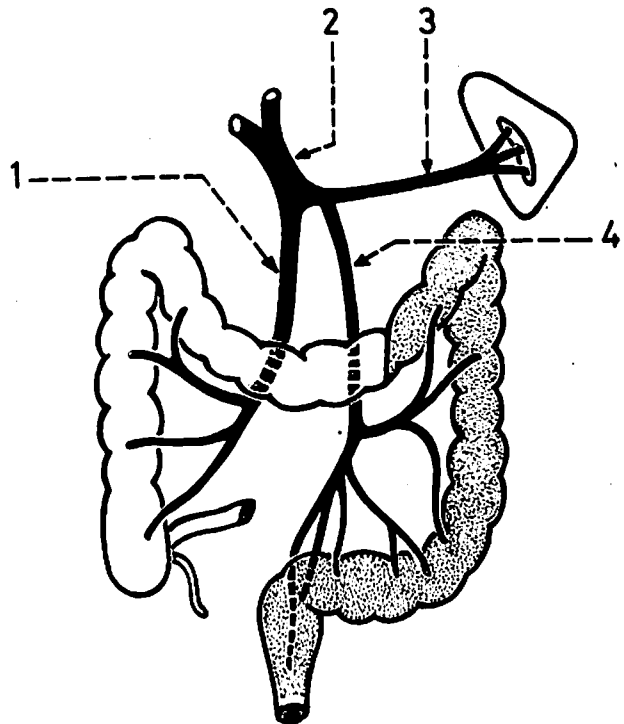


Fig.(184): PARASYMPATHETIC NERVE SUPPLY
OF LARGE INTESTINE

- (a) Parts supplied by the vagus nerve: these are the appendix, caecum, ascending colon, right colic flexure and right 2/3 of the transverse colon.
- (b) Parts supplied by the pelvic splanchnic nerve: the fibres of this nerve originate from the 2nd, 3rd and 4th sacral segments of spinal cord and supply the left 1/3 of the transverse colon, left colic flexure, descending colon, sigmoid colon and rectum.

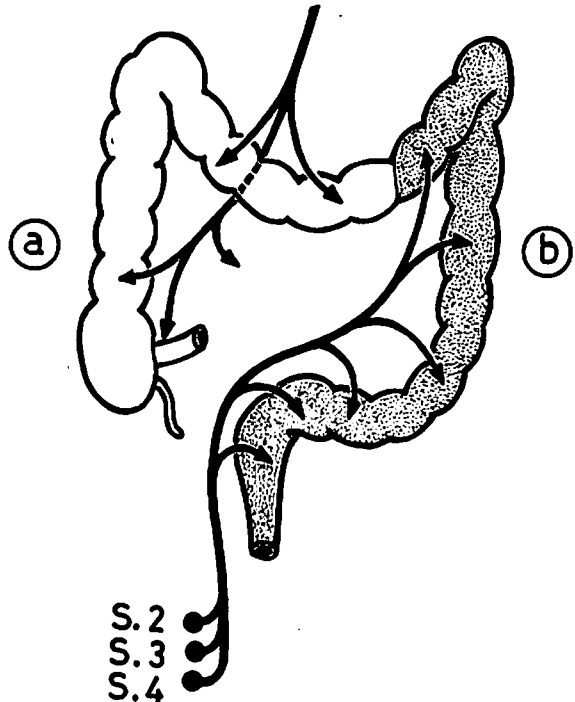


Fig.(185): GROUPS OF LYMPH NODES
DRAINING THE COLON

The lymph nodes of the colon are arranged in 4 groups: epicolic nodes, paracolic nodes, intermediate nodes and terminal nodes.

1. epicolic nodes: are minute nodes situated directly on the wall of the colon.
2. paracolic nodes: lie close and parallel to the inner border of the ascending and descending colon, and to the mesenteric borders of the transverse and sigmoid colon.
3. intermediate nodes: lie along the colic arteries.
4. terminal nodes: are the largest and lie along the superior and inferior mesenteric arteries.

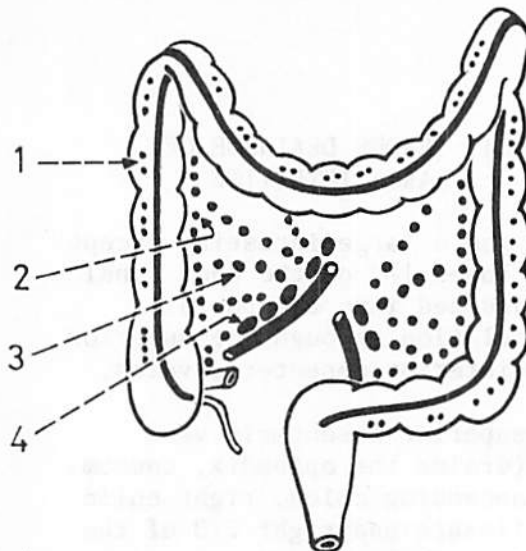


Fig.(186): ARRANGEMENT OF LYMPH NODES
DRAINING THE COLON

1. epicolic nodes.
2. paracolic nodes.
3. intermediate nodes.
4. terminal nodes.

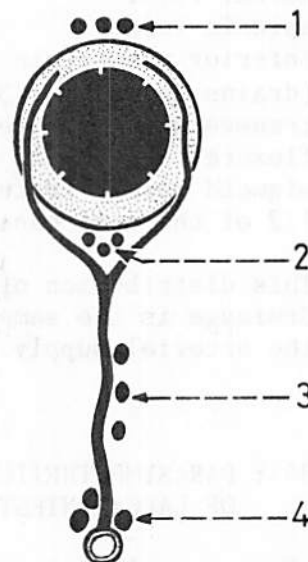
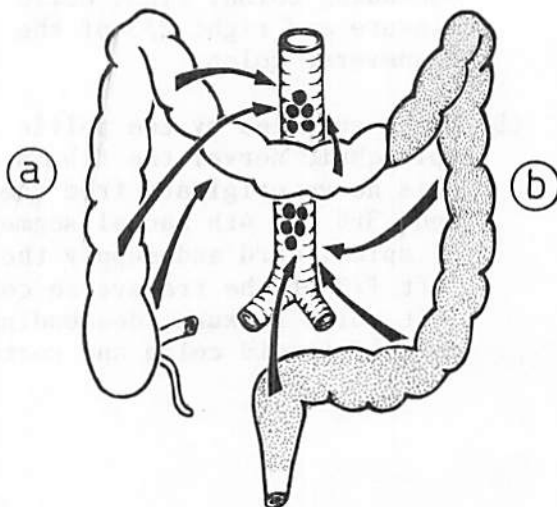


Fig.(187): DISTRIBUTION OF LYMPHATIC
DRAINAGE OF LARGE INTESTINE

The lymph vessels of the large intestine accompany the branches of the superior and inferior mesenteric arteries and end in terminal lymph nodes situated at the origin of these arteries from the front of the abdominal aorta, namely, the superior mesenteric nodes and the inferior mesenteric nodes.

- (a) Parts of large intestine draining finally into the superior mesenteric nodes.
- (b) Parts of large intestine draining finally into the inferior mesenteric nodes.

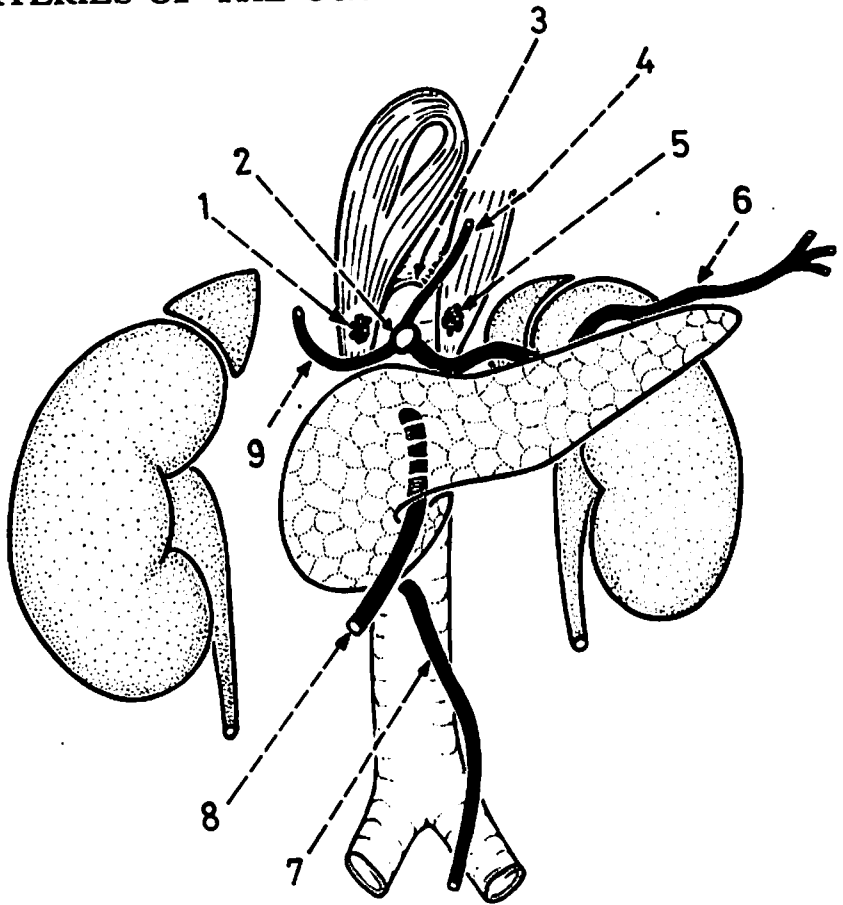


ARTERIES OF THE GUT

Fig.(188): ARTERIES OF THE GUT

The gut is supplied by the coeliac, superior mesenteric and inferior mesenteric arteries which arise from the front of the aorta in close relation to the head of pancreas.

1. right coeliac ganglion.
2. coeliac trunk.
3. median arcuate ligament arching over the aorta.
4. left gastric artery (from the coeliac).
5. left coeliac ganglion.
6. splenic artery (from the coeliac).
7. inferior mesenteric artery.
8. superior mesenteric artery.
9. hepatic artery (from the coeliac).



* The coeliac trunk arises just above the head of pancreas, the superior mesenteric behind it, while the inferior mesenteric arises just below it.

Fig.(189): LEFT GASTRIC ARTERY

It is the smallest branch of the coeliac trunk. It passes upwards and to the left behind the lesser sac as far as the cardiac end of the stomach, then curves downwards along the lesser curvature in the lesser omentum.

1. oesophageal branches of left gastric artery.
2. left gastric artery.
3. coeliac trunk.
4. hepatic artery.
5. right gastric artery.

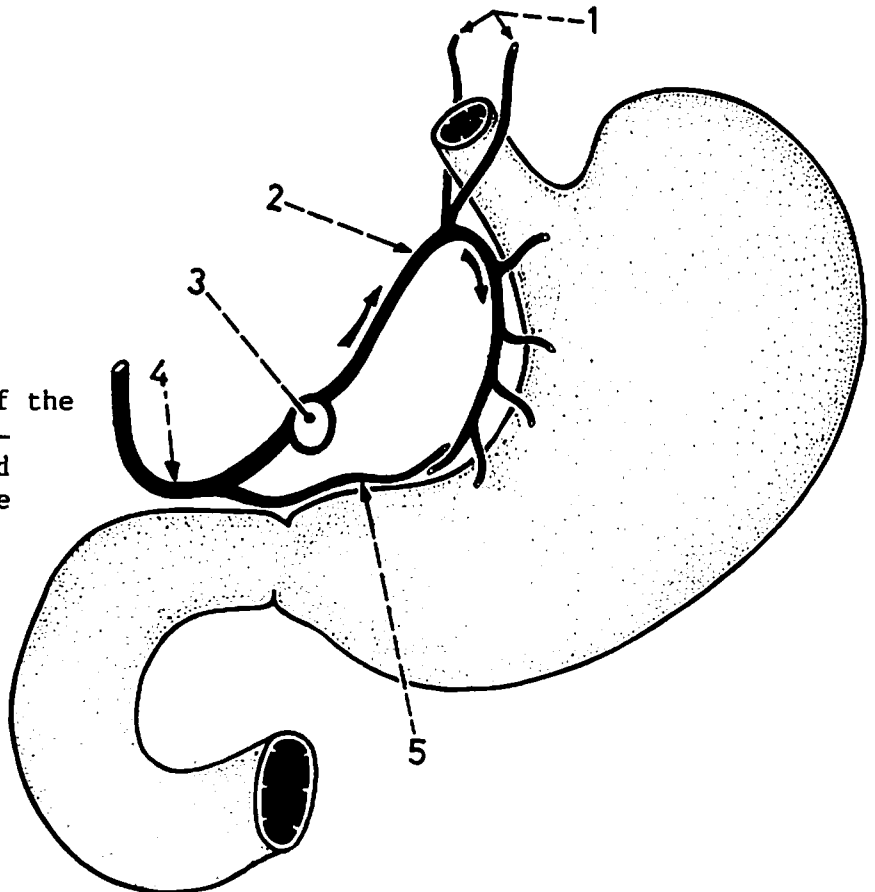


Fig.(190): HEPATIC ARTERY

It arises from the coeliac trunk and passes downwards and to the right behind the lesser sac as far as the superior part of the duodenum (common hepatic artery). It then ascends in the free border of lesser omentum to reach the liver (hepatic artery proper).

1. cystic artery.
2. cystic duct of gall bladder.
3. bile duct to the right of the hepatic artery.
4. supraduodenal artery (to the duodenum).
5. gastroduodenal artery.
6. right hepatic branch.
7. left hepatic branch.
8. hepatic artery proper.
9. coeliac trunk.
10. common hepatic artery.
11. right gastric artery.
12. right gastroepiploic artery.
13. superior pancreaticoduodenal artery.

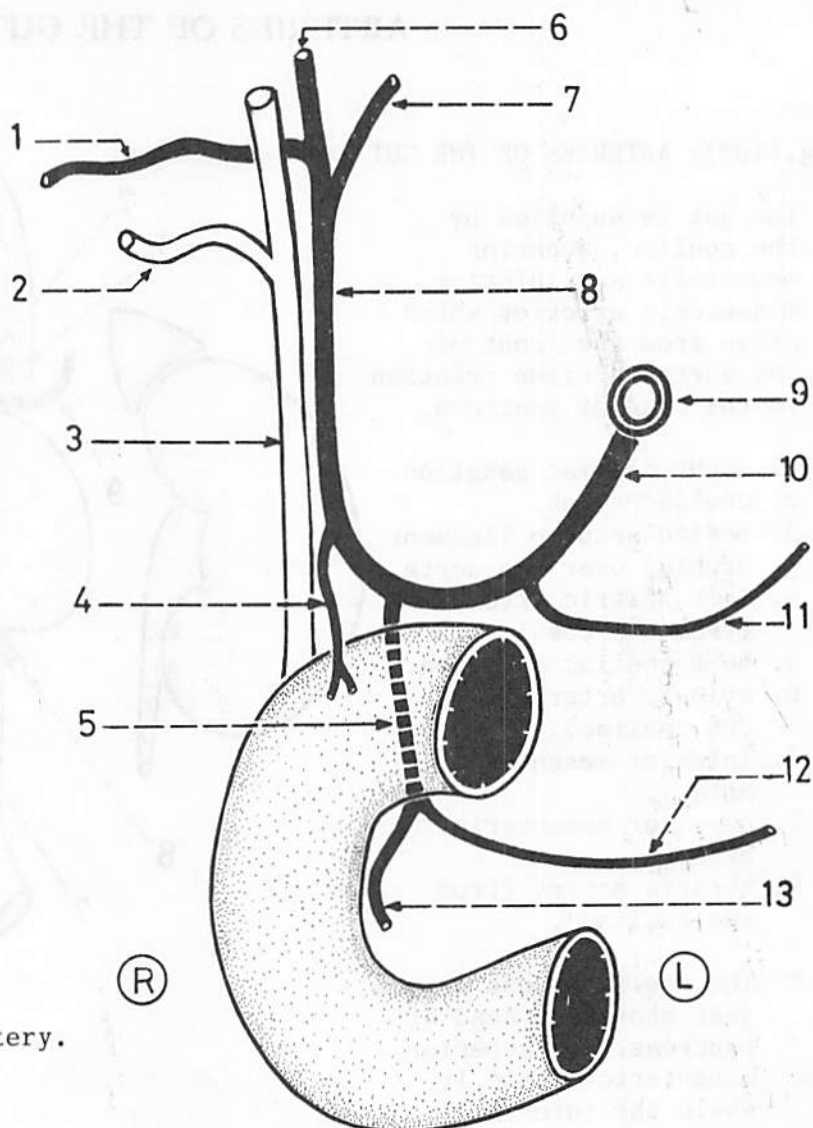
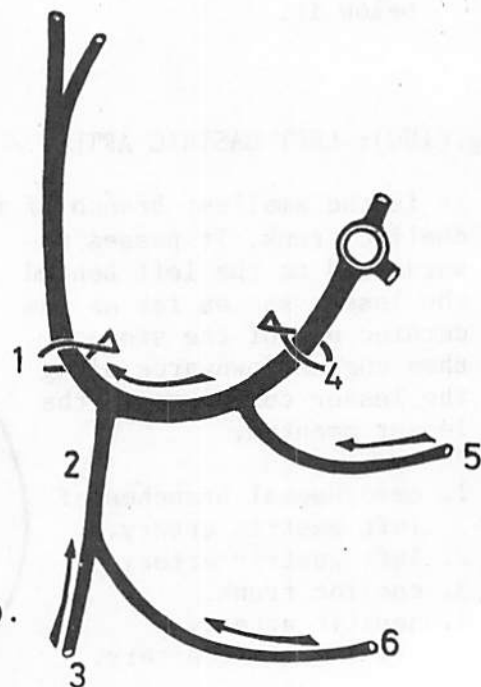


Fig.(191): LIGATION OF THE HEPATIC ARTERY

Ligation of the hepatic artery distal to its gastroduodenal branch will cut the blood supply to the liver, while ligation proximal to the right gastric branch allows for collateral circulation to supply the liver.

1. hepatic artery proper ligated (dangerous site).
2. gastro-duodenal artery.
3. superior pancreaticoduodenal artery.
4. common hepatic artery ligated (not dangerous).
5. right gastric artery.
6. right gastro-epiploic artery.



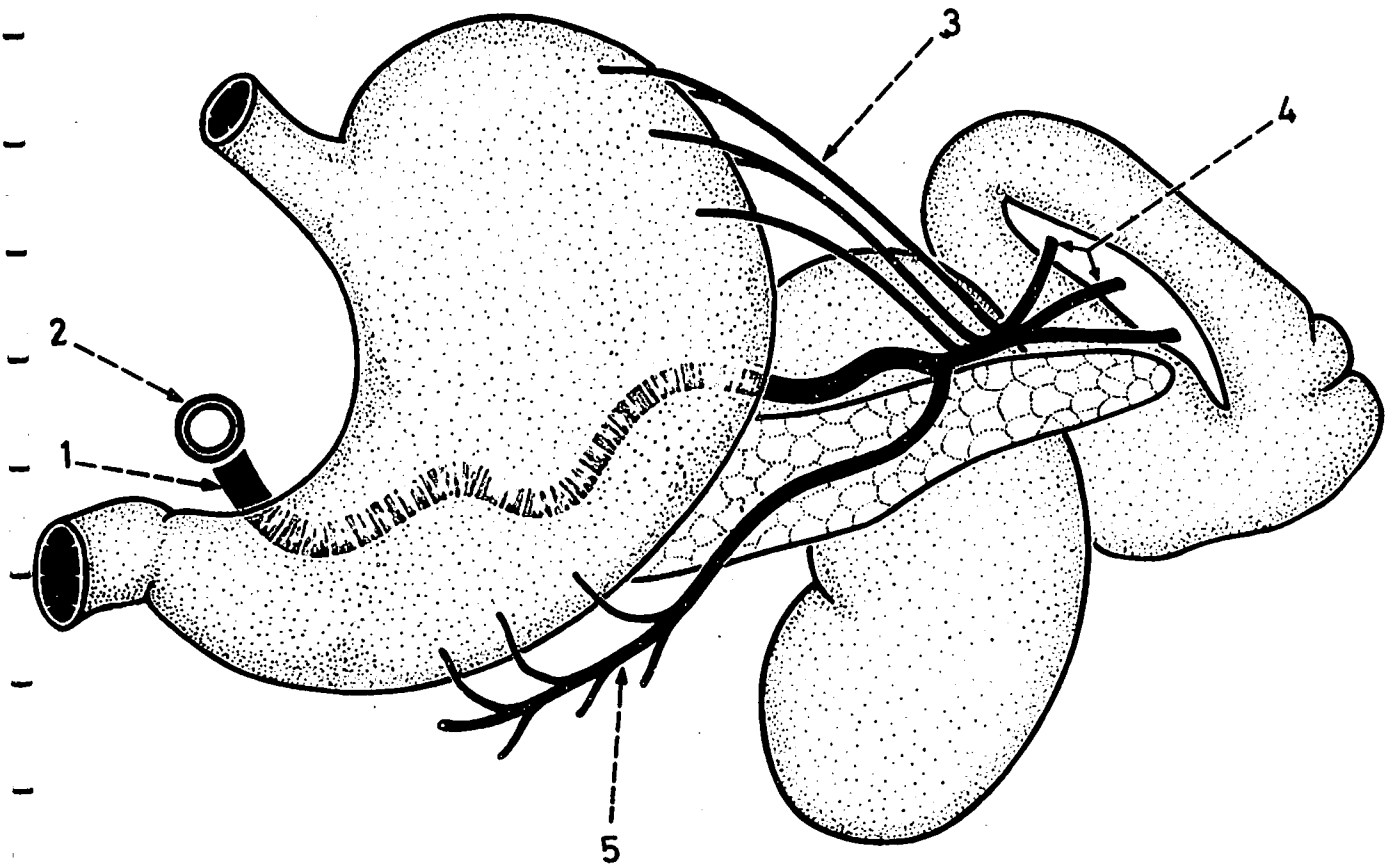


Fig.(192): SPLENIC ARTERY

The splenic artery is the largest branch of the coeliac trunk and is characterized by being tortuous. It runs a horizontal course from right to left along the upper border of the pancreas to reach the hilum of the spleen. It runs most of its course behind the lesser sac and its terminal part in the lieno-renal ligament.

* Each of the branches of the coeliac trunk runs the proximal part of its course behind the lesser sac and the distal part of its course in a peritoneal fold (lesser omentum or lieno-renal ligament).

1. splenic artery (runs to the left in the stomach bed).
2. coeliac trunk.
3. short gastric branches (arise from the terminal part of the splenic artery and ascend in the gastro-splenic ligament to reach the fundus of the stomach).
4. terminal branches of the splenic artery (enter the hilum of the spleen).
5. left gastro-epiploic artery (arises from the terminal part of the splenic artery and descends in the greater omentum along the greater curvature of the stomach).

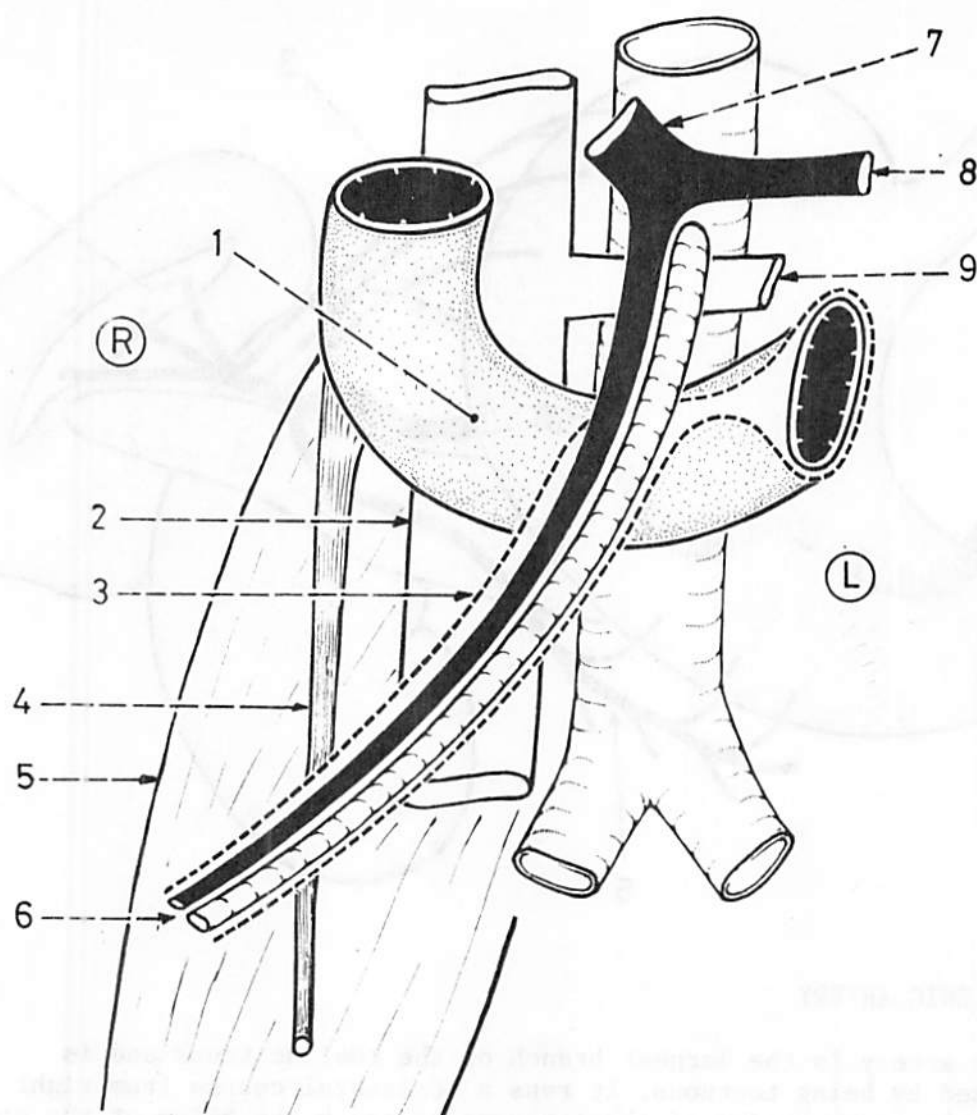


Fig.(193): SUPERIOR MESENTERIC ARTERY AND VEIN

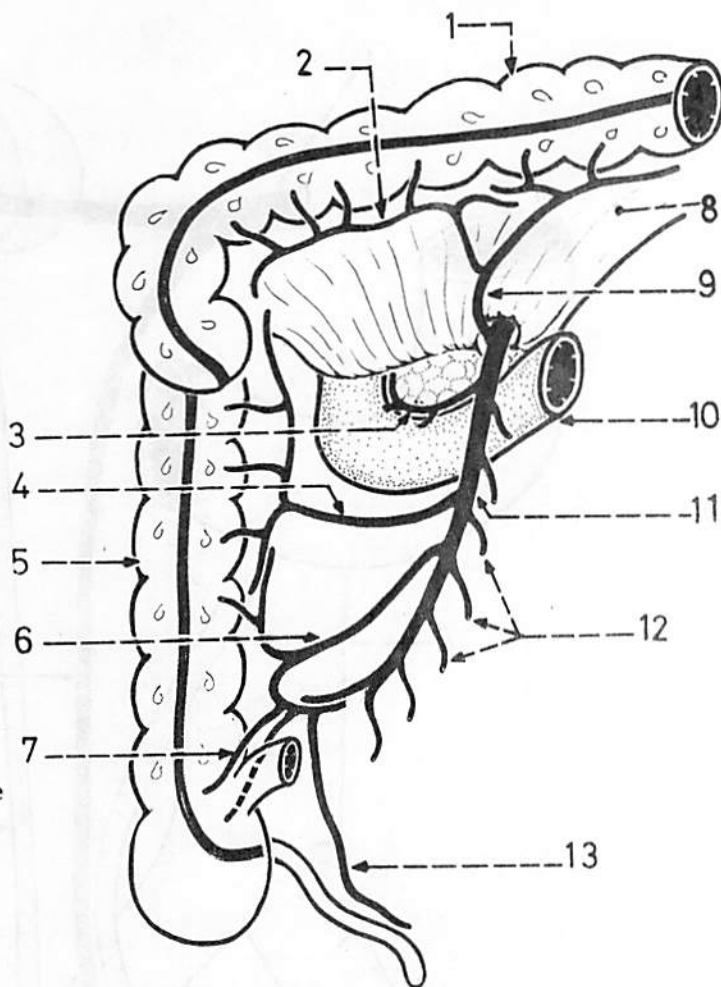
The superior mesenteric artery arises from the front of the aorta behind the neck of the pancreas where it lies between the splenic vein above and the left renal vein below. It courses downwards and to the right in the root of the mesentery to end at the ileo-caecal junction. It crosses over the following structures in succession: uncinat process of pancreas, horizontal part of duodenum, inferior vena cava, right ureter and psoas major. It has the superior mesenteric vein on its right side.

1. horizontal part of duodenum.
2. inferior vena cava.
3. root of mesentery.
4. right ureter.
5. right psoas major.
6. superior mesenteric artery and vein (the vein is to the right of the artery).
7. portal vein.
8. splenic vein.
9. left renal vein.

Fig.(194): BRANCHES OF SUPERIOR MESENTERIC ARTERY

These are: inferior pancreatico-duodenal, jejunal, ileal, ileo-colic, right colic and and middle colic.

1. transverse colon.
2. marginal artery.
3. inferior pancreatico-duodenal artery.
4. right colic artery.
5. ascending colon.
6. ileo-colic artery.
7. anterior caecal artery.
8. transverse mesocolon (reflected upwards).
9. middle colic artery (running in the transverse mesocolon).
10. duodenum.
11. superior mesenteric artery.
12. jejunal and ileal branches.
13. appendicular artery.

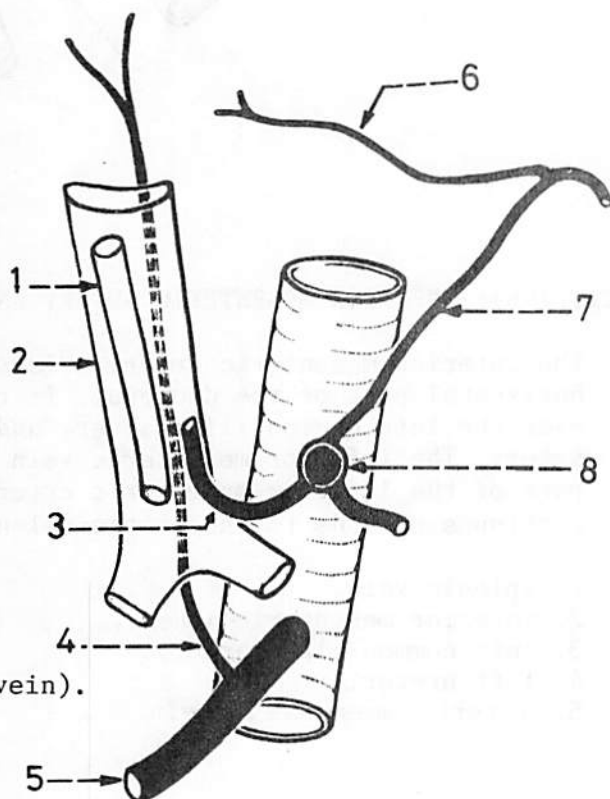


* The marginal artery lies close and parallel to the colon and is formed by the anastomosis between all the colic arteries.

Fig.(195): ACCESSORY HEPATIC ARTERIES

An accessory right hepatic artery may exist having its origin from the superior mesenteric artery. An accessory left hepatic artery may exist arising from the left gastric artery.

1. bile duct.
2. portal vein.
3. normal hepatic artery.
4. accessory right hepatic artery (passing upwards behind the portal vein).
5. superior mesenteric artery.
6. accessory left hepatic artery.
7. left gastric artery.
8. coeliac trunk.



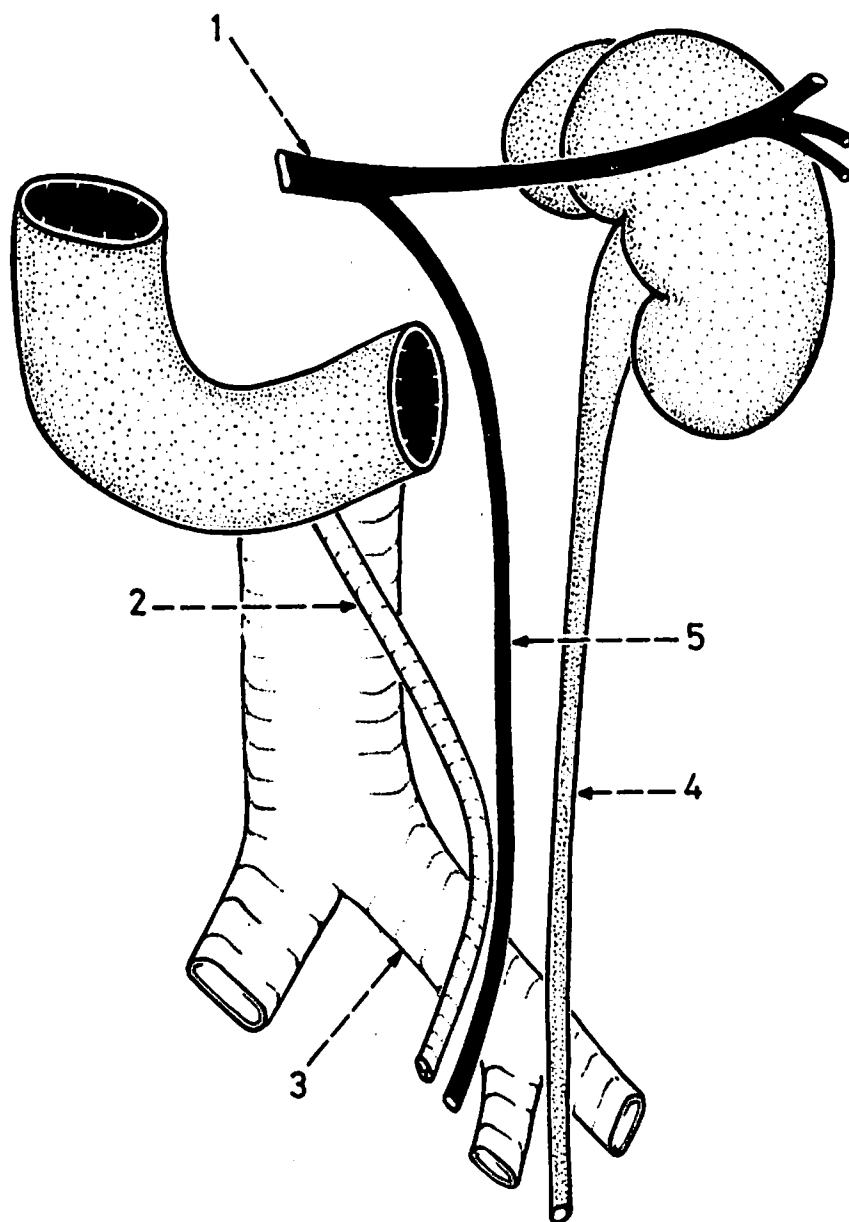


Fig.(196): INFERIOR MESENTERIC ARTERY AND VEIN

The inferior mesenteric artery arises from the front of aorta behind the horizontal part of the duodenum. It runs downwards and to the left to cross over the left common iliac artery and is continued as the superior rectal artery. The inferior mesenteric vein ascends along the left side of the lower part of the inferior mesenteric artery but it deviates from it above and continues upwards to end in the splenic vein.

1. splenic vein.
2. inferior mesenteric artery.
3. left common iliac artery.
4. left ureter.
5. Inferior mesenteric vein.

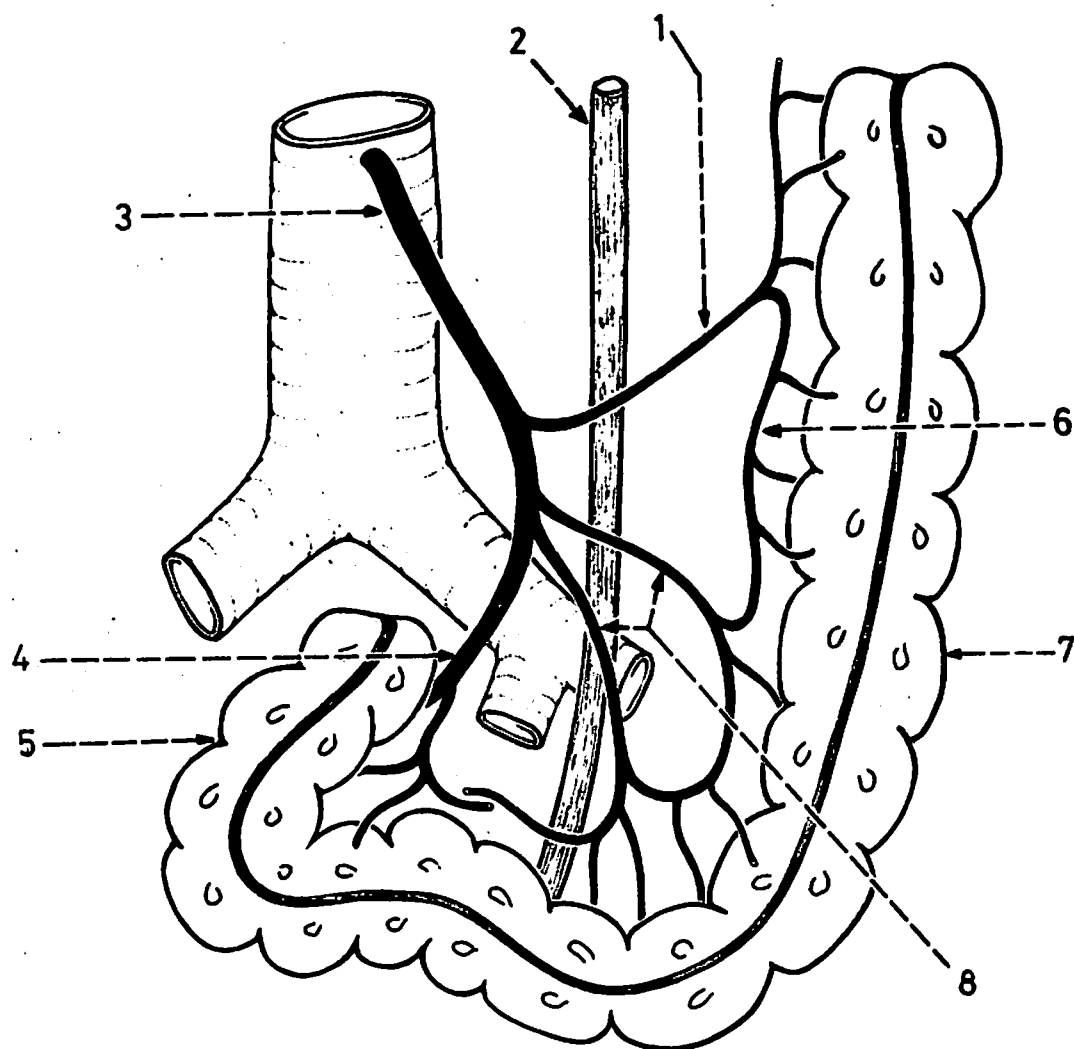


Fig.(197): BRANCHES OF THE INFERIOR MESENTERIC ARTERY

The inferior mesenteric artery gives off the left colic and sigmoid branches which supply the left 1/3 of the transverse colon, left colic flexure, descending colon and sigmoid colon. The continuation of the inferior mesenteric artery- after crossing the left common iliac artery- is called the superior rectal artery which supplies the rectum.

1. left colic artery: runs upwards and to the left in front of the left ureter. Near the descending colon it divides into ascending and descending branches.
2. left ureter crossed by the branches of the inferior mesenteric artery.
3. inferior mesenteric artery.
4. superior rectal artery: descends to the rectum in the medial limb of sigmoid mesocolon.
5. sigmoid colon.
6. marginal artery: a continuous artery formed by the anastomosis of the terminations of the colic arteries near the colon.
7. descending colon.
8. sigmoid branches: 2-3 branches which run downwards and to the left to reach the sigmoid colon and lower part of the descending colon.

LIVER

Fig.(198): POSITION OF THE LIVER

The liver occupies the right hypochondrium, epigastrium and part of the left hypochondrium.

1. part of the liver in the right hypochondrium.
2. part of the liver in the epigastrium.
3. small part of the liver in the left hypochondrium.

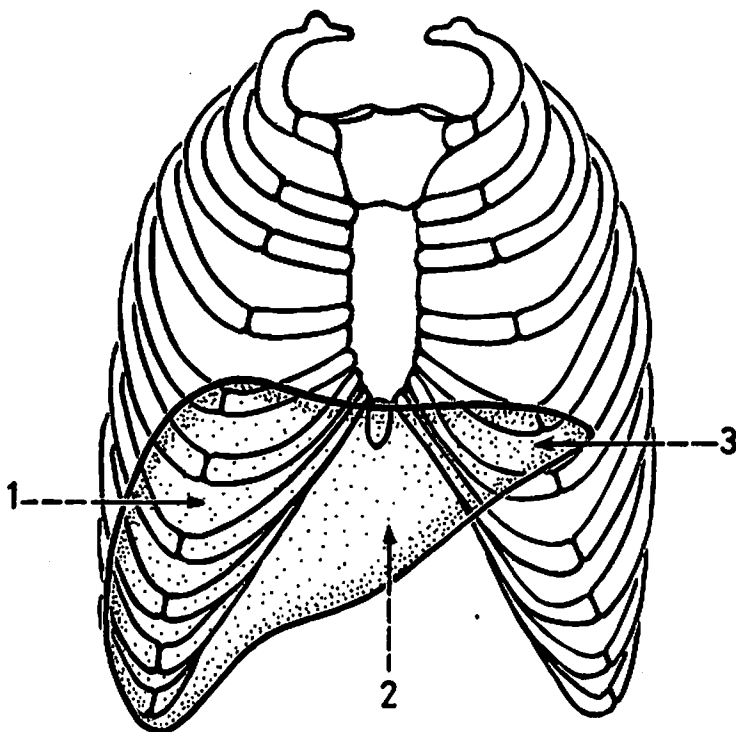


Fig.(199): SURFACES OF THE LIVER

The liver has 5 surfaces: anterior, superior, inferior, posterior and right surfaces. The anterior, superior and right surfaces are continuous together smoothly with no sharp borders in between. However, the inferior surface is separated from the anterior and right surfaces by a sharp inferior border which is marked by 2 notches (for the gall bladder and ligamentum teres).

1. superior surface.
2. posterior surface.
3. right surface.
4. inferior surface.
5. anterior surface.

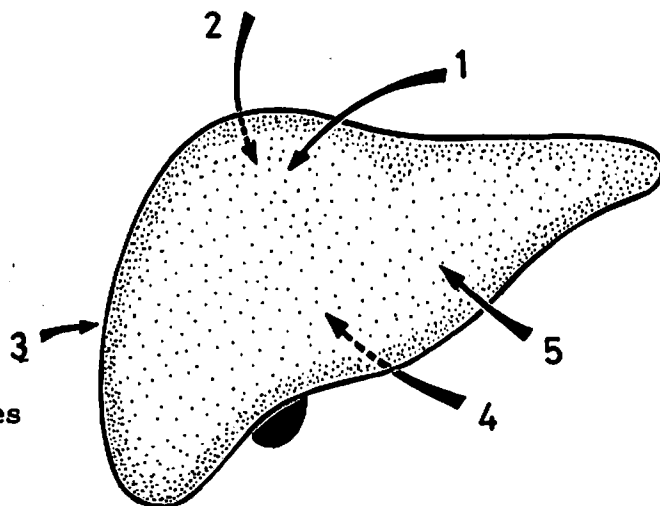


Fig.(200): RIGHT AND LEFT LOBES
OF THE LIVER

The liver is divided into a large right lobe and a smaller left lobe by the attachment of the falciform ligament (on the anterior and superior surfaces), fissure for ligamentum teres (on the inferior surface) and fissure for ligamentum venosum (on the posterior surface). This means that the 2 lobes are separated by a circular line.

1. inferior vena cava.
2. right lobe of liver.
3. fundus of gall bladder.
4. left lobe of liver.
5. attachment of falciform ligament to the anterior and superior surfaces.

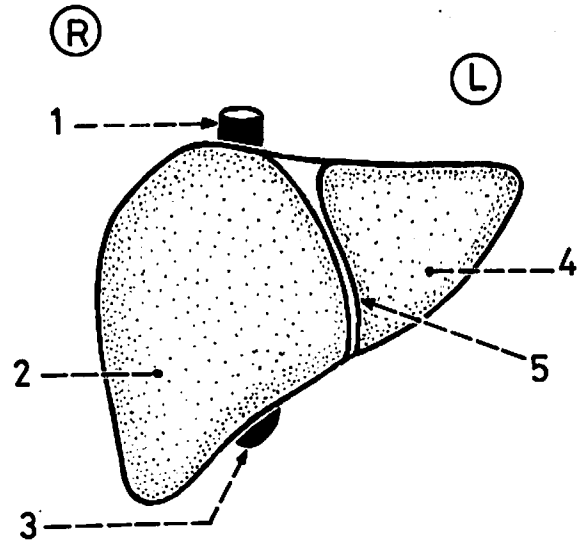


Fig.(201): QUADRATE AND CAUDATE LOBES

These are 2 small lobes which belong to the right lobe. The quadrate lobe lies on the inferior surface between the gall bladder and the fissure for ligamentum teres. The caudate lobe lies on the posterior surface between the groove for inferior vena cava and the fissure for ligamentum venosum.

1. left lobe of liver.
2. fissure for ligamentum teres.
3. quadrate lobe.
4. gall bladder.
5. fissure for ligamentum venosum.
6. caudate lobe.
7. inferior vena cava.
8. right lobe of liver.

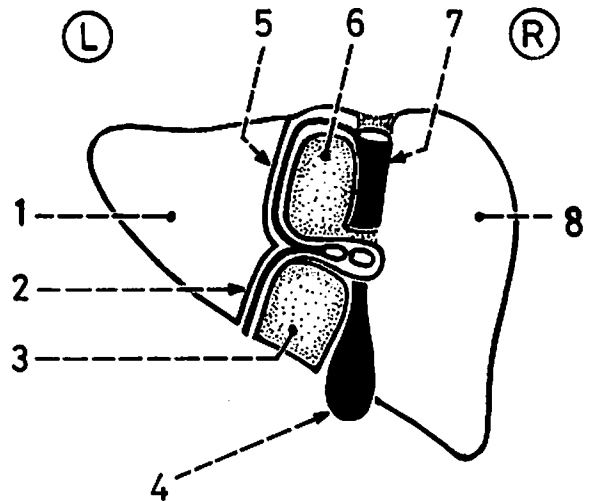
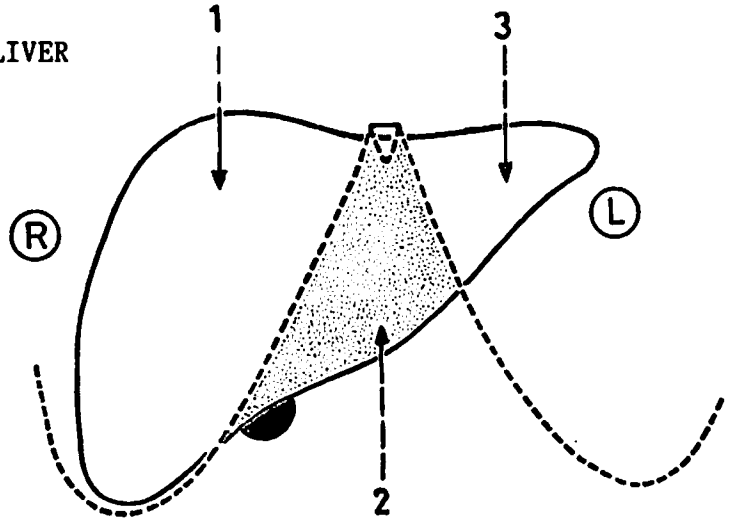


Fig.(202): ANTERIOR SURFACE OF THE LIVER

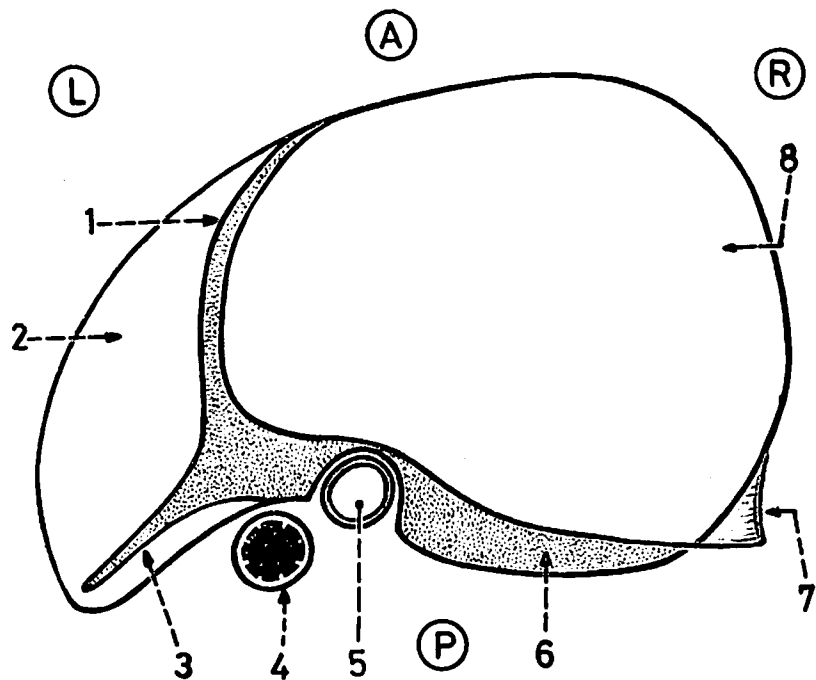
It is triangular in shape and is related to the diaphragm and to the anterior abdominal wall.

1. right part of the anterior surface of the liver which is related to the diaphragm. The diaphragm separates this surface from 6, 7, 8, 9, 10 ribs.
2. median part of the anterior surface related directly to the anterior abdominal wall in the epigastric region.
3. left part of the anterior surface related to the diaphragm. This area is of limited extent, and the diaphragm separates it from the 7th and 8th costal cartilages (not ribs).

Fig.(203): SUPERIOR SURFACE OF THE LIVER
(as seen from above)

The superior surface of the liver is related to the diaphragm which separates it from the base of the right lung, base of pericardium and a small part of the base of the left lung.

1. site of attachment of the falciform ligament.
2. superior surface of the left lobe of liver.
3. left triangular ligament on the posterior surface.
4. abdominal part of oesophagus.
5. inferior vena cava.
6. bare area of the liver on the posterior surface.
7. right triangular ligament (it is the right extremity of the coronary ligament).
8. superior surface of the right lobe.



* Note that this figure shows the whole superior surface and a part of the posterior surface behind it.

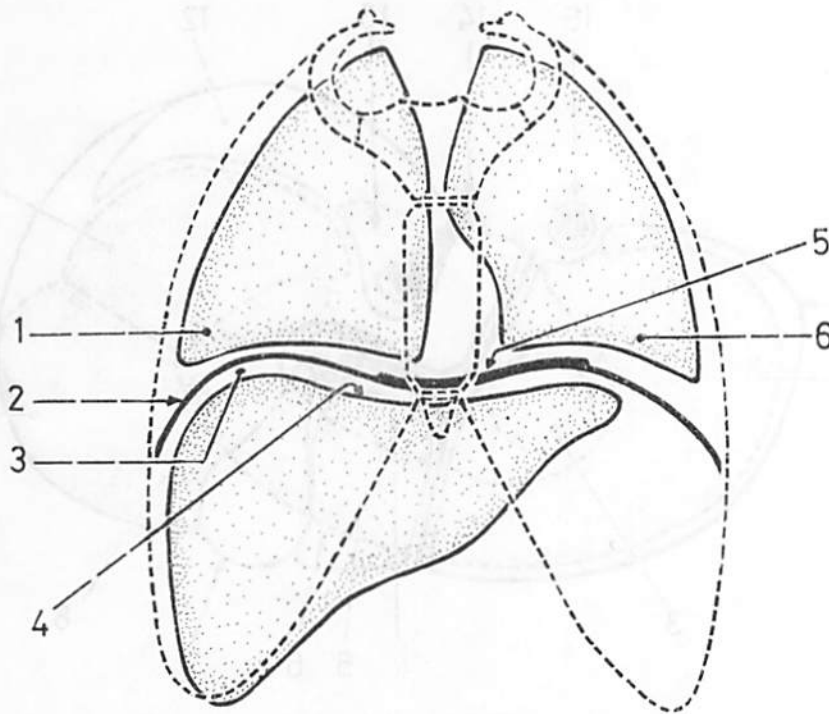


Fig.(204): STRUCTURES ABOVE THE LIVER (as seen in coronal section)

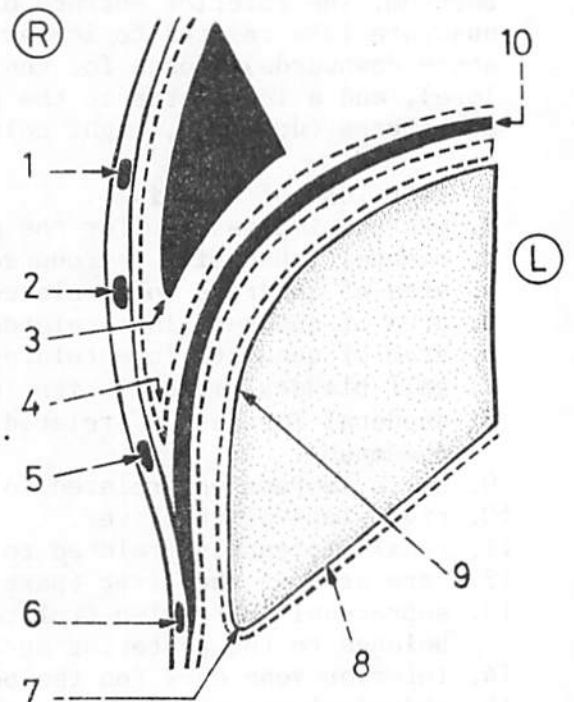
The liver is related superiorly to the diaphragm with the subphrenic space in between. The diaphragm separates the liver from the base of the right lung, base of pericardium and part of the base of the left lung.

1. base of right lung.
2. diaphragm.
3. subphrenic space.
4. superior surface of the liver.
5. base of pericardium.
6. base of left lung.

Fig.(205): RIGHT SURFACE OF THE LIVER
(as seen in coronal section)

The right surface of the liver is related to the diaphragm which separates it from the right lung, costo-diaphragmatic recess of right pleura and ribs from 7 to 11.

1. 7th rib.
2. 8th rib.
3. right lung.
4. right costo-diaphragmatic recess.
5. 10th rib.
6. 11th rib.
7. inferior border of the liver.
8. inferior surface of the liver.
9. right surface of the liver.
10. diaphragm covered by pleura and lung.



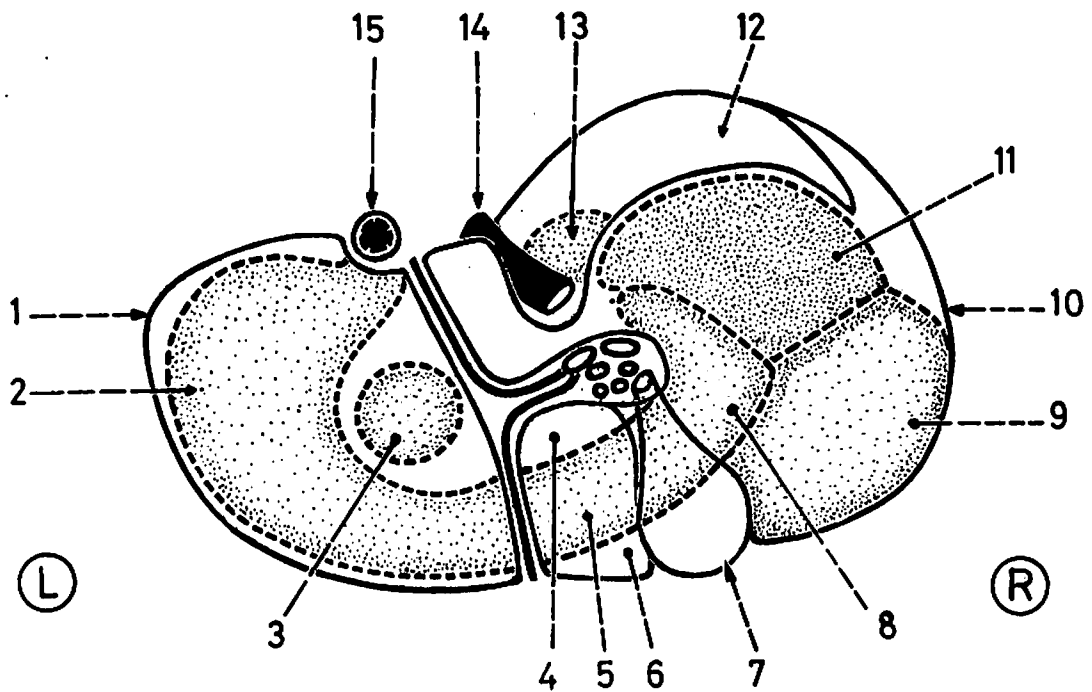


Fig.(206): INFERIOR (VISCERAL) SURFACE OF THE LIVER

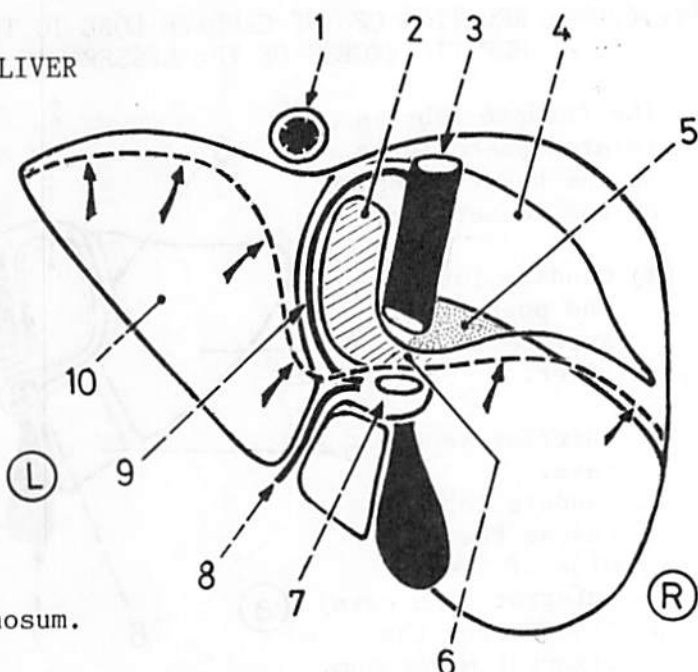
This surface is directed downwards, backwards and to the left and is in relation with abdominal viscera (hence its name visceral). Near its junction with the posterior surface, the liver shows the porta hepatis which is a transverse slit between the quadrate lobe and the caudate process of the caudate lobe.

The inferior surface of the left lobe is related to the stomach and lesser omentum. The inferior surface of the right lobe consists of: surface of the quadrate lobe related to lesser omentum, pylorus and transverse colon (from above downwards), fossa for the gall bladder (to the right of the quadrate lobe), and a large area to the right of the gall bladder related to 3 structures (duodenum, right colic flexure and right kidney).

1. left lobe of the liver.
2. gastric impression (for the anterior surface of the stomach).
3. omental tuberosity (a rounded elevation related to the lesser omentum).
4. area of quadrate lobe related to lesser omentum.
5. area of quadrate lobe related to pylorus and superior part of duodenum.
6. area of quadrate lobe related to the beginning of the transverse colon.
7. gall bladder lying in its fossa.
8. duodenal impression (related to the end of the superior part of the duodenum).
9. colic impression (related to the right colic flexure).
10. right lobe of the liver.
11. renal impression (related to the upper part of the right kidney).
12. bare area of the liver (part of the posterior surface).
13. suprarenal impression (related to suprarenal gland; this impression belongs to the posterior surface of the liver).
14. inferior vena cava (on the posterior surface).
15. abdominal oesophagus (related to the posterior border of the left lobe).

Fig.(207): POSTERIOR SURFACE OF THE LIVER

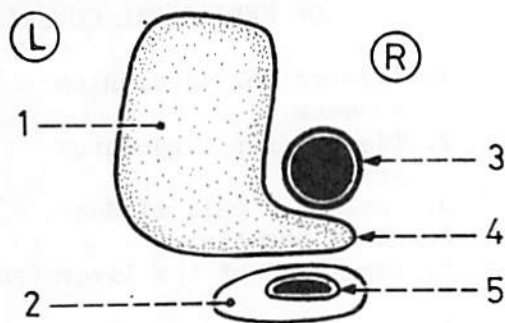
The right part of the posterior surface (to the right of the fissure for ligamentum venosum) is wide and belongs to the right lobe. It is marked by the bare area, impression for suprarenal gland, groove for inferior vena cava and caudate lobe. The left part of the posterior surface (to the left of the fissure for ligamentum venosum) is narrow and shows a notch for the abdominal oesophagus close to the fissure for ligamentum venosum.



1. abdominal oesophagus.
2. caudate lobe (between the inferior vena cava and fissure for ligamentum venosum; it has a caudate process which is directed to the right between the groove for the inferior vena cava and porta hepatis).
3. inferior vena cava in its groove.
4. bare area of liver (a large triangular area devoid of peritoneum).
5. area for suprarenal gland.
6. caudate process of caudate lobe.
7. porta hepatis.
8. fissure for ligamentum teres (on the inferior surface).
9. fissure for ligamentum venosum (on the posterior surface).
10. inferior surface of the liver (it is continuous with the posterior surface along a rounded border marked by arrows).

Fig.(208): CAUDATE LOBE AND ITS CAUDATE PROCESS

The caudate lobe is a part of the right lobe situated on the posterior surface of the liver between the groove for the inferior vena cava and fissure for the ligamentum venosum. Its caudate process extends to the right as a narrow strip between the groove for inferior vena cava and porta hepatis.



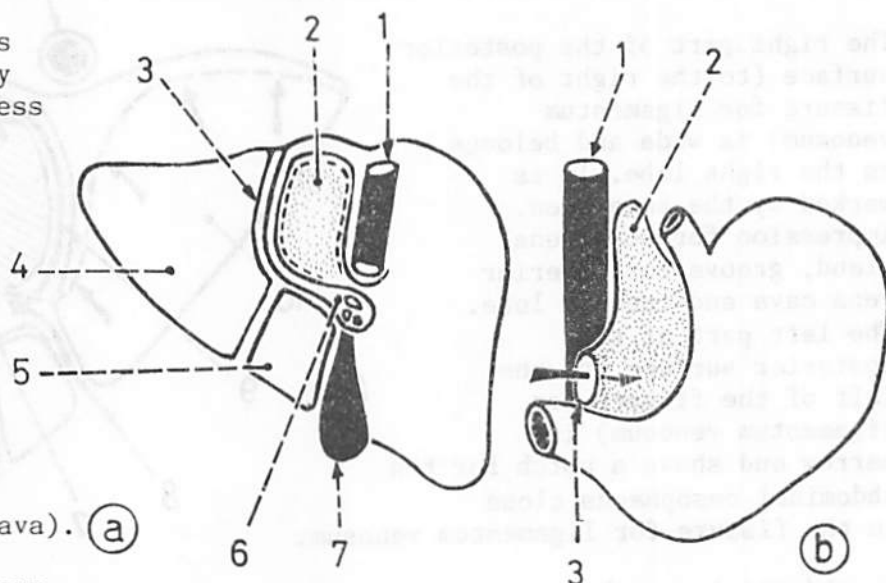
1. caudate lobe.
2. porta hepatis.
3. inferior vena cava.
4. caudate process of caudate lobe.
5. portal vein in the porta hepatis.

Fig.(209): RELATION OF THE CAUDATE LOBE TO THE HEPATIC RECESS OF THE LESSER SAC

The caudate lobe is related posteriorly to the hepatic recess of the lesser sac.

(a) Caudate lobe on the posterior surface of the liver.

1. inferior vena cava.
2. caudate lobe (along the left side of the inferior vena cava).
3. fissure for the ligamentum venosum.
4. left lobe (inferior surface).
5. quadrate lobe.
6. porta hepatis.
7. gall bladder.



(b) Hepatic recess of lesser sac.

1. inferior vena cava.
2. hepatic recess of lesser sac (extends upwards along the right side of the inferior vena cava behind the caudate lobe, thus called hepatic).
3. opening into lesser sac (epiploic foramen).

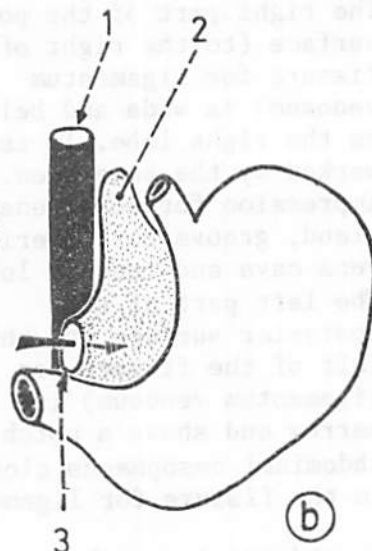


Fig.(210): AREAS OF THE LIVER DEVOID OF PERITONEAL COVERING

1. fissure for ligamentum venosum.
2. fissure for ligamentum teres.
3. fossa for gall bladder.
4. porta hepatis.
5. bare area of the liver (the largest).

* The bare area of the liver is triangular in outline with its base directed to the left and corresponds to the groove for inferior vena cava, while its apex is directed to the right.

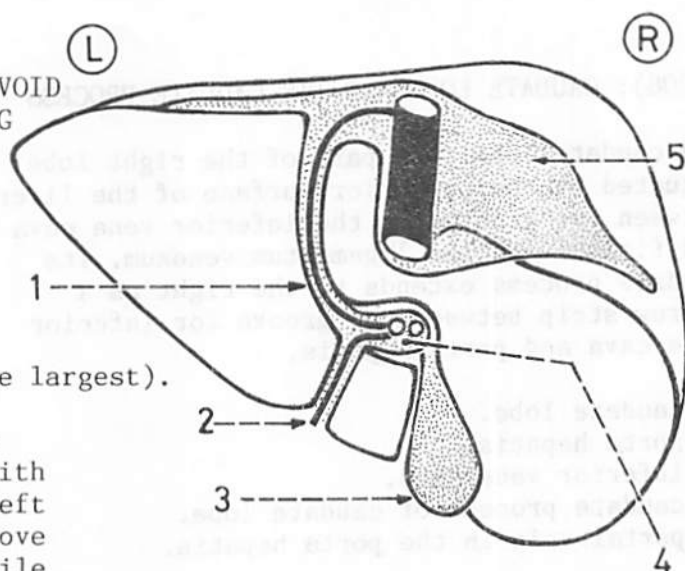


Fig.(211): FALCIFORM LIGAMENT

It is a sickle-shaped fold of peritoneum which connects the liver to the diaphragm and upper part of the anterior abdominal wall.

1. convex margin attached to the diaphragm.
2. lower part of the convex margin attached to the anterior abdominal wall above the umbilicus.
3. umbilicus.
4. free border of the ligament extending from the umbilicus to the liver and lodges the ligamentum teres.
5. concave margin attached to the anterior and superior surfaces of the liver.

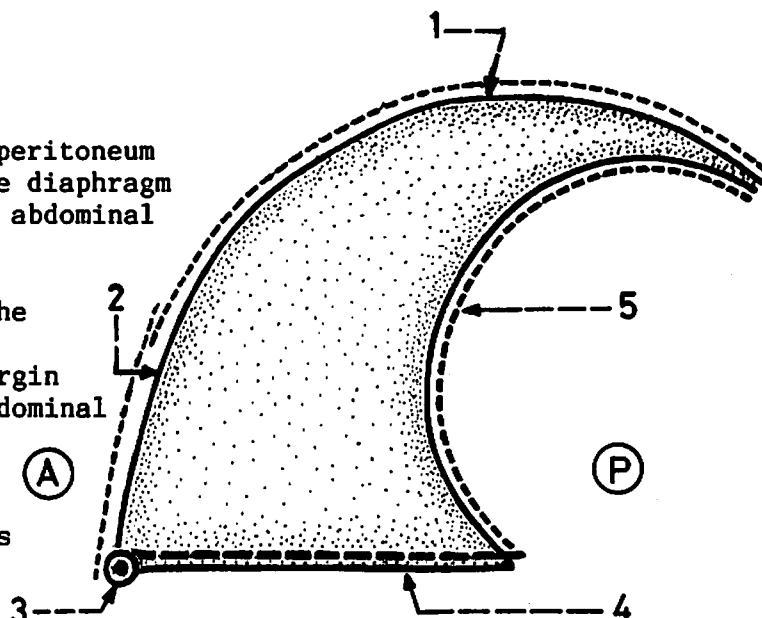


Fig.(212): LINE OF ATTACHMENT OF THE FALCIFORM LIGAMENT TO THE LIVER

The ligament is attached to the anterior and superior surfaces of the liver between the right and left lobes. On the posterior surface of the liver, the 2 layers of the ligament are continuous with the coronary and left triangular ligaments.

1. coronary ligament.
2. upper surface of right lobe.
3. right layer of falciform ligament.
4. free edge of falciform ligament enclosing the ligamentum teres.
5. left layer of falciform ligament.
6. upper surface of left lobe.
7. left triangular ligament.
8. abdominal oesophagus.

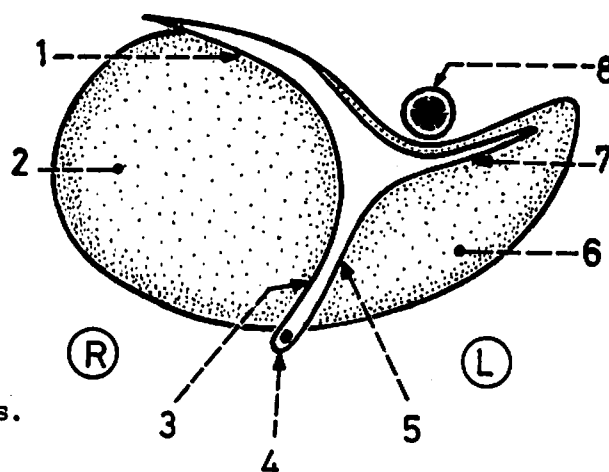
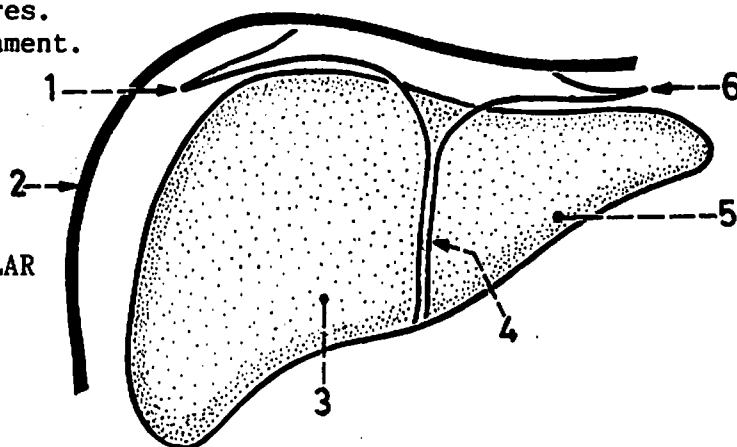


Fig.(213): RIGHT AND LEFT TRIANGULAR LIGAMENTS

1. right triangular ligament.
2. diaphragm.
3. right lobe.
4. falciform ligament.
5. left lobe.
6. left triangular ligament.



* The right triangular ligament is the free right edge of the coronary ligament.

Fig.(214): LIGAMENTUM TERES AND LIGAMENTUM VENOSUM

1. inferior vena cava.
2. ligamentum venosum: extends from the left branch of the portal vein to the inferior vena cava.
3. veins radiating from the umbilicus.
4. umbilicus.
5. ligamentum teres surrounded by para-umbilical veins. This ligament extends from the left branch of portal vein to the umbilicus.
6. left branch of portal vein.

* The ligamentum teres is the obliterated left umbilical vein, while the ligamentum venosum is the obliterated ductus venosus.

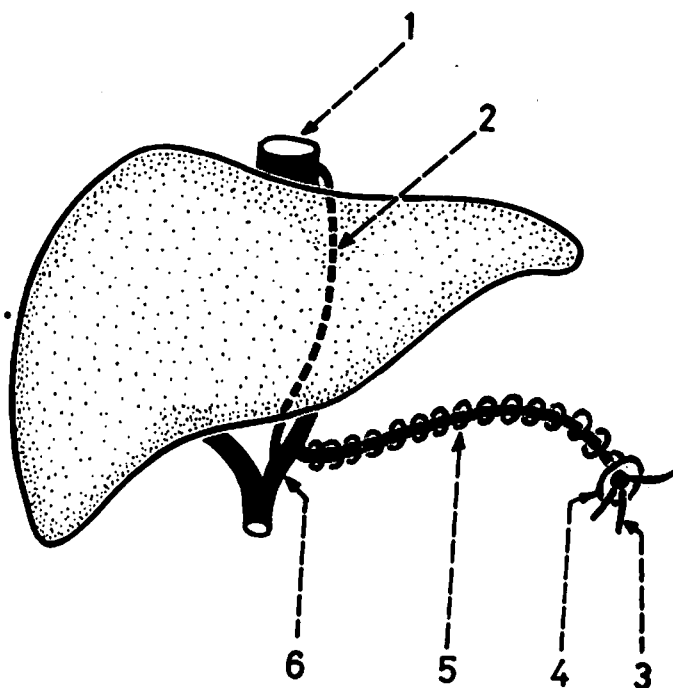
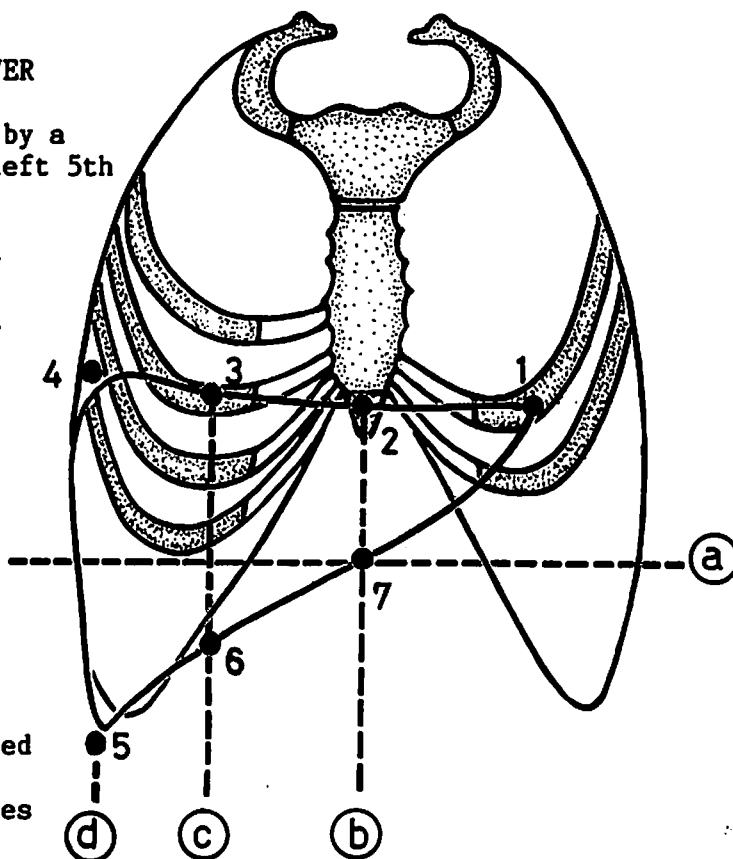


Fig.(215): SURFACE ANATOMY OF THE LIVER

* Upper border: it is represented by a line drawn from a point on the left 5th rib in the midclavicular line (point 1) to a point on the right 7th rib in the midaxillary line (point 4). This line runs transversely crossing the xiphisternal junction in the midline (point 2) and the right 5th rib in the midclavicular line (point 3).

* Right border: it is represented by a line drawn on the right side in the midaxillary line from point (4) down to a point situated 1/2 an inch below the costal margin (point 5).

* Inferior border: it is represented by an oblique line drawn from point (5) to point (1). It crosses the right midclavicular line 1/2 an inch below the costal margin (point 6) and the midline in the transpyloric plane (point 7).



(a) transpyloric plane; (b) midline; (c) right midclavicular line;
(d) right midaxillary line.

Fig.(216): MAIN FACTORS FIXING THE LIVER IN POSITION

1. ligaments of the liver.
2. attachment of the hepatic veins to the inferior vena cava.
3. pressure of the surrounding viscera.

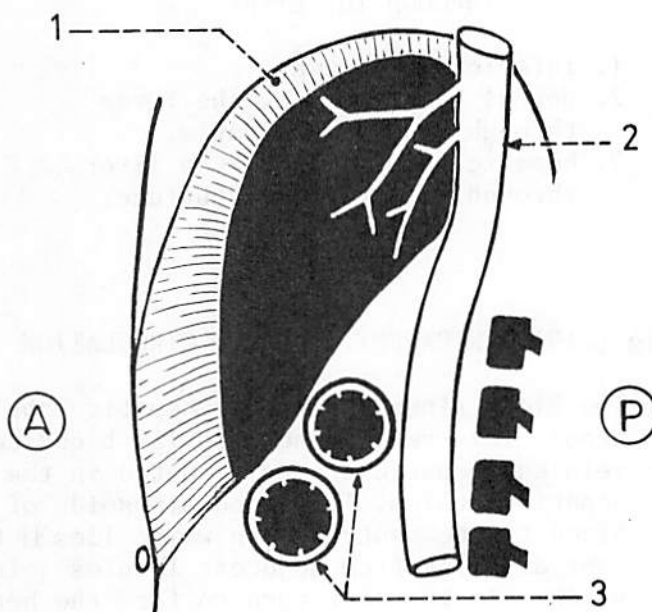
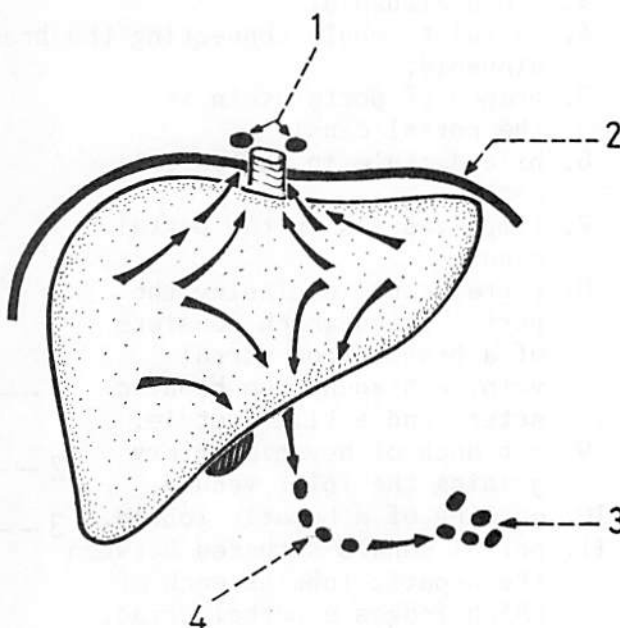


Fig.(217): LYMPH DRAINAGE OF THE LIVER

The lymph vessels of the liver, whether superficial or deep, pass in 2 different directions: one group of vessels pass upwards along the inferior vena cava and enter the chest through the opening for this vein to end in the lymph nodes on the upper surface of the diaphragm around the termination of the inferior vena cava; the other group pass downwards and emerge from the porta hepatis to end in the hepatic nodes situated along the hepatic artery and then finally into the coeliac lymph nodes



1. diaphragmatic lymph nodes on the upper surface of diaphragm around termination of the inferior vena cava.
2. diaphragm.
3. coeliac nodes around the coeliac trunk.
4. hepatic nodes along the hepatic artery.

Fig.(218): FLOW OF VENOUS BLOOD FROM THE PORTAL VEIN TO THE INFERIOR VENA CAVA THROUGH THE LIVER

1. inferior vena cava.
2. portal vein entering the liver through the porta hepatis.
3. hepatic veins leaving the liver through its posterior surface.

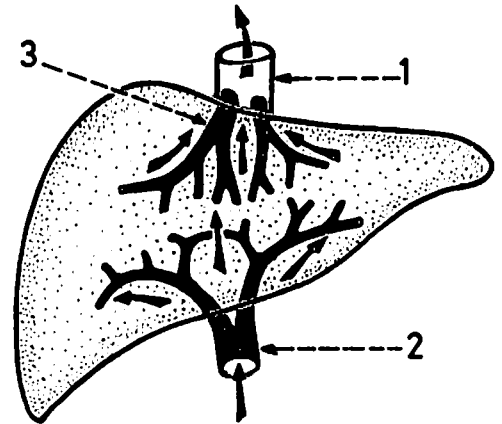
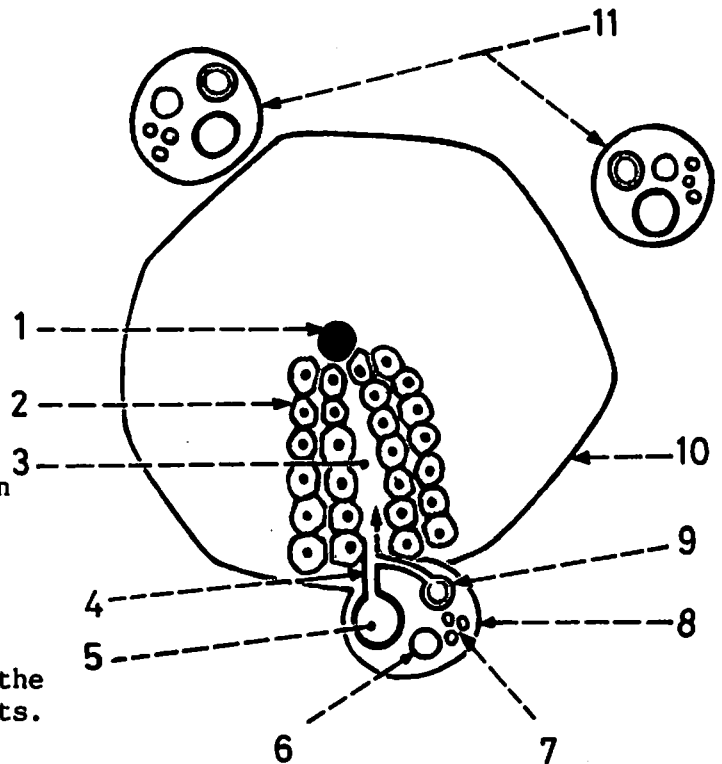


Fig.(219): INTRAHEPATIC BLOOD CIRCULATION

The blood sinusoids of the hepatic lobules receive both venous and arterial blood. This venous and arterial blood comes from the branches of the portal vein and hepatic artery situated in the portal canals placed between the hepatic lobules. The blood sinusoids of the hepatic lobule convey this mixed blood to the central vein which lies in the central axis of the lobule. The central veins from adjacent lobules join together to form sublobular veins which join in their turn to form the hepatic veins.

1. central vein of the hepatic lobule.
2. columns of liver cells.
3. blood sinusoid.
4. an inlet venule connecting the branch of the portal vein to the blood sinusoid.
5. branch of portal vein in the portal canal.
6. bile ductule in the portal canal.
7. lymph vessels in the portal canal.
8. portal canal enclosing the portal triad which consists of a branch from portal vein, a branch from hepatic artery and a bile ductule.
9. a branch of hepatic artery joining the inlet venule.
10. outline of a hepatic lobule.
11. portal canals situated between the hepatic lobules each of which lodges a portal triad.

* Each portal triad supplies a specific segment of the liver and does not anastomose with the triads of neighbouring segments.



GALL BLADDER AND BILE DUCT

Fig.(220): PARTS OF THE GALL BLADDER

The gall bladder consists of a fundus, body and neck. The neck is continuous with the cystic duct which joins the common hepatic duct to form the bile duct.

1. body of gall bladder.
2. fundus (the expanded lower part).
3. Hartmann's pouch (a small pouch which projects downwards and backwards from the neck towards the duodenum; not always present).
4. bile duct.
5. common hepatic duct.
6. cystic duct.
7. neck of gall bladder (the narrow upper part and has 2 curves: upwards and forwards and then backwards and downwards).

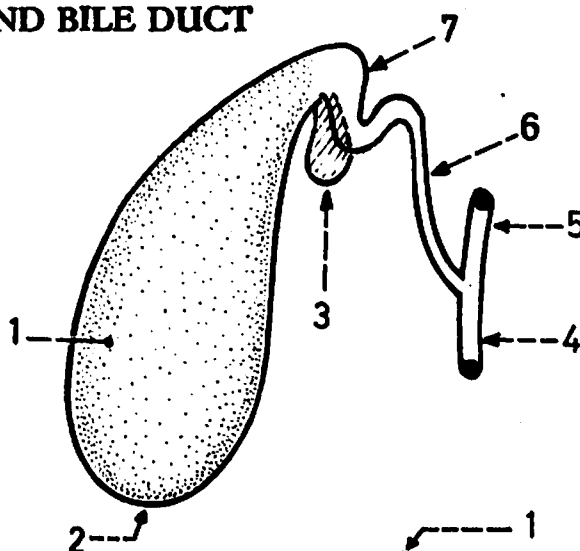


Fig.(221): MUCOUS MEMBRANE OF THE NECK OF GALL BLADDER

The mucous membrane of the neck projects into the lumen in the form of a spiral ridge called spiral valve.

1. neck of gall bladder.
2. spiral valve.
3. body of gall bladder.
4. fundus of gall bladder.

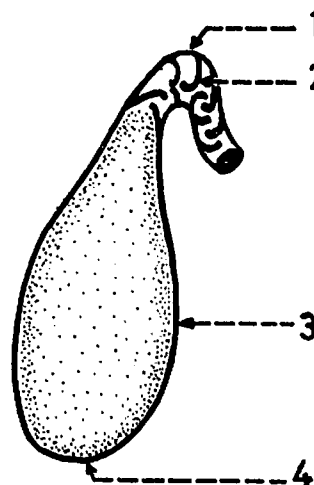


Fig.(222): POSITION OF THE GALL BLADDER

The gall bladder is a pear-shaped sac situated in a fossa on the inferior surface of the right lobe of the liver. Its fundus is directed downwards towards the inferior border of the liver while its neck is directed upwards towards the porta hepatis. It is covered by peritoneum except its surface which is in contact with the liver.

1. anterior abdominal wall.
2. fossa for gall bladder.
3. body of gall bladder.
4. fundus (covered by peritoneum).
5. inferior border of the liver.

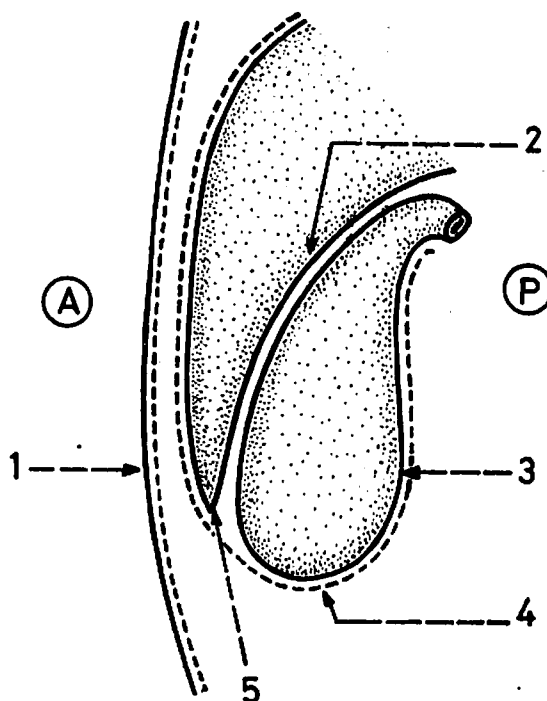


Fig.(223): X-RAY PICTURE OF THE GALL BLADDER USING A DYE (cholecystogram)

The gall bladder appears as a pear-shaped sac on the right side in the area bounded by the last rib and upper lumbar vertebrae.

1. right last rib.
2. neck of gall bladder.
3. fundus of gall bladder.
4. bile duct (descends vertically opposite the 2nd and 3rd lumbar transverse processes).
5. iliac crest.

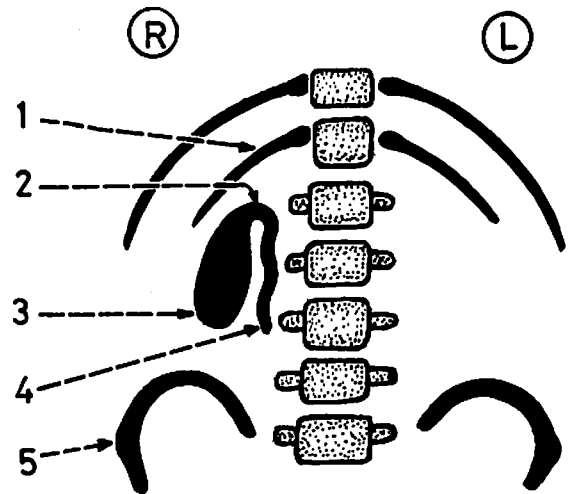


Fig.(224): SURFACE ANATOMY OF THE FUNDUS OF GALL BLADDER

The fundus of gall bladder projects downwards and forwards beyond the inferior border of the liver so as to come in direct contact with the anterior abdominal wall.

The fundus is represented on the surface by a point at the tip of the right 9th costal cartilage. This point corresponds to the point where the linea semilunaris crosses the right costal margin.

1. fundus of gall bladder opposite the tip of the right 9th costal cartilage.
2. linea semilunaris which corresponds to the lateral edge of the rectus abdominis.

* Note that the inferior border of the liver extends about $\frac{1}{2}$ inch below the costal margin and that the fundus of gall bladder projects beyond the inferior border of the liver, therefore the fundus comes in contact with the anterior abdominal wall.

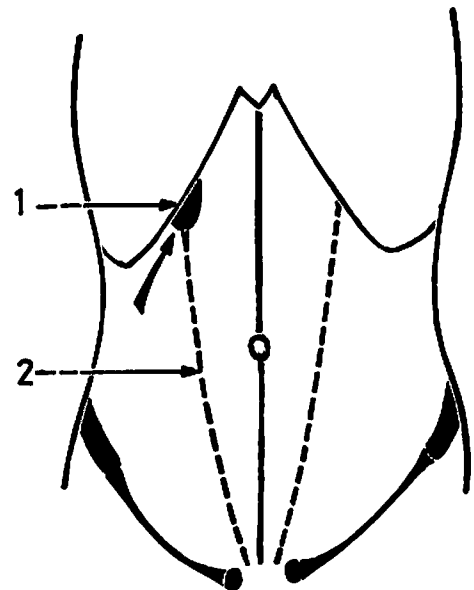


Fig.(225): RELATIONS OF THE GALL BLADDER

The fundus lies over the beginning of the transverse colon while the body lies over the superior part and the beginning of the descending part of the duodenum. The upper end of the body reaches up to the right end of the porta hepatis.

1. porta hepatis.
2. neck of gall bladder.
3. body of gall bladder.
4. superior part of duodenum.
5. beginning of transverse colon.

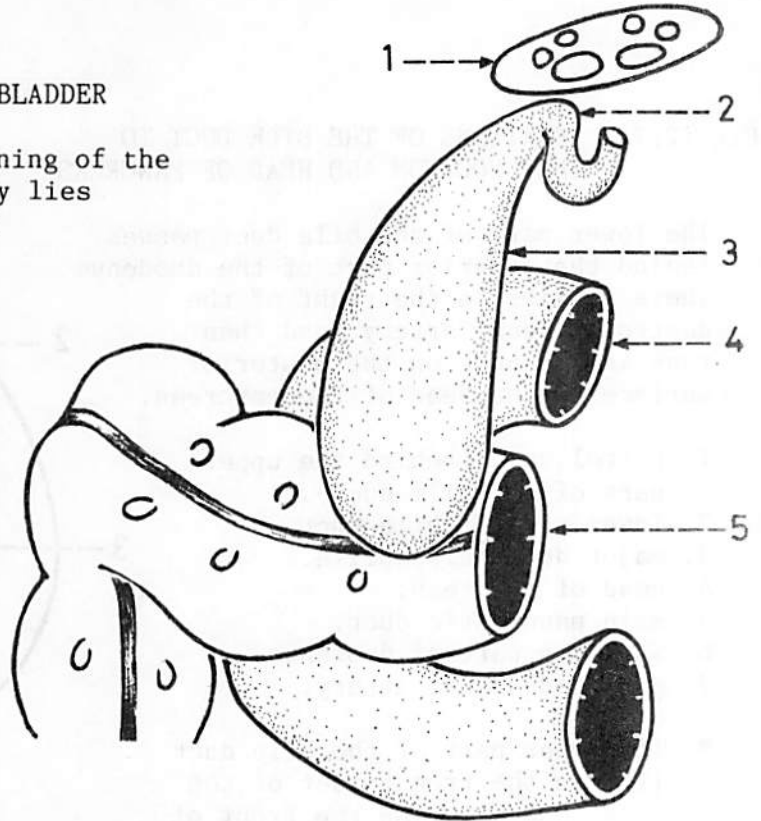


Fig.(226): BILIARY DUCTS

The bile is collected from the liver by the right and left hepatic ducts which join each other at the porta hepatis to form the common hepatic duct. Shortly below the porta hepatis the common hepatic duct joins the cystic duct to form the bile duct which descends vertically to open together with the main pancreatic duct in the middle of the descending part of the duodenum.

1. right hepatic duct.
2. cystic artery to the gall bladder.
3. fundus of gall bladder.
4. descending part of the duodenum.
5. greater duodenal papilla.
6. porta hepatis.
7. common hepatic duct.
8. cystic lymph node.
9. hepatic artery.
10. bile duct (its upper part lies in the free border of the lesser omentum while its lower part is deeply placed on the posterior surface of the head of the pancreas).
11. main pancreatic duct.

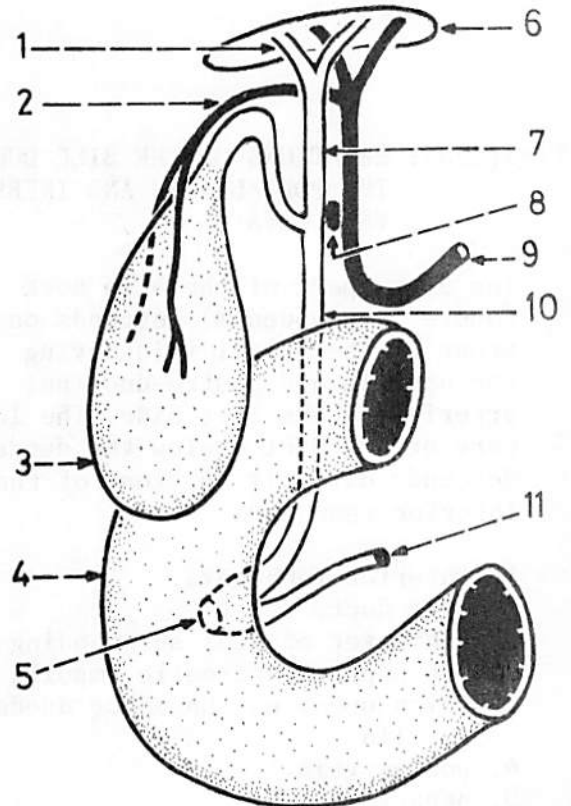


Fig.(227): RELATIONS OF THE BILE DUCT TO THE DUODENUM AND HEAD OF PANCREAS

The lower part of the bile duct passes behind the superior part of the duodenum where it lies to the right of the gastro-duodenal artery, and then runs in a groove on the posterior surface of the head of the pancreas.

1. portal vein (behind the upper part of the bile duct).
2. lower part of bile duct.
3. major duodenal papilla.
4. head of pancreas.
5. main pancreatic duct.
6. superior part of duodenum.
7. gastro-duodenal artery.

* The upper part of the bile duct lies in the free border of the lesser omentum, on the front of portal vein.

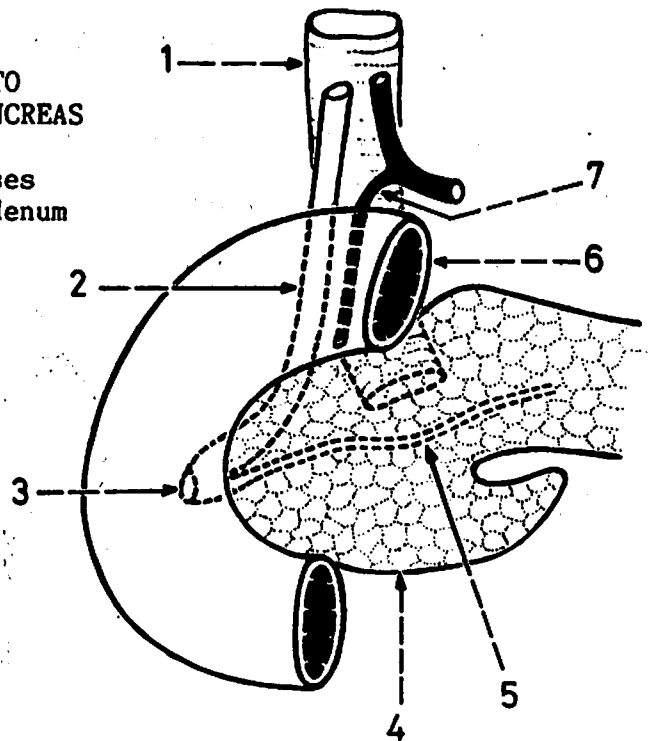
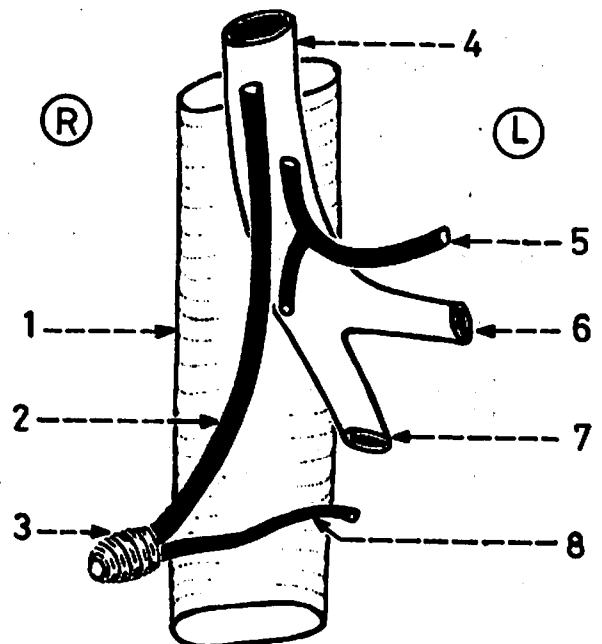


Fig.(228): RELATIONS OF THE BILE DUCT TO THE PORTAL VEIN AND INFERIOR VENA CAVA

The upper part of the bile duct (above the duodenum) descends on the front of the portal vein having the hepatic and gastro-duodenal arteries on its left side. The lower part of the duct (below the duodenum) descends directly in front of the inferior vena cava.

1. inferior vena cava.
2. bile duct.
3. sphincter of Oddi surrounding the hepato-pancreatic ampulla which opens on the major duodenal papilla.
4. portal vein.
5. hepatic artery.
6. splenic vein.
7. superior mesenteric vein.
8. main pancreatic duct.



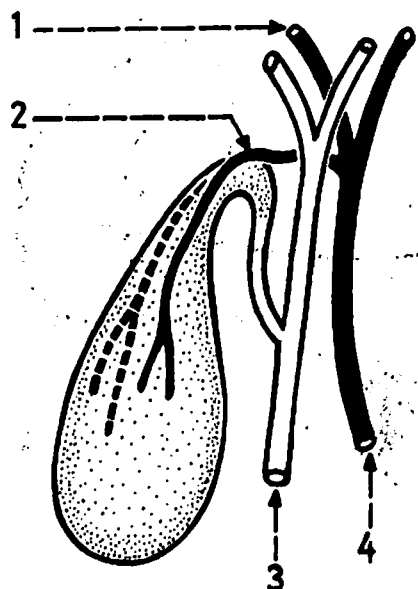


Fig.(229): ARTERIAL SUPPLY OF GALL BLADDER

The gall bladder is supplied by the cystic artery which arises from the right branch of hepatic artery.

1. right branch of hepatic artery.
2. cystic artery (passes behind the common hepatic duct).
3. bile duct.
4. hepatic artery.

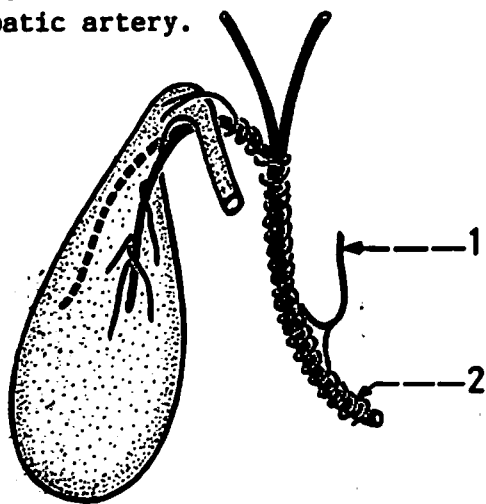


Fig.(231): NERVE SUPPLY OF GALL BLADDER

Sympathetic fibres reach the gall bladder through the hepatic plexus around the hepatic artery. Fibres from the right phrenic nerve join this plexus.

1. fibres from right phrenic nerve.
2. sympathetic plexus (hepatic plexus).

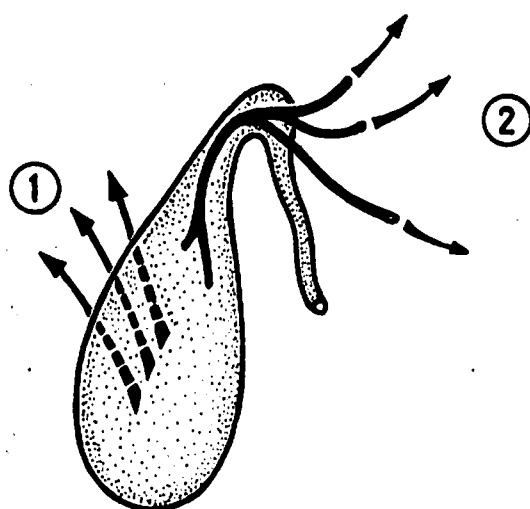


Fig.(230): VENOUS DRAINAGE OF GALL BLADDER

1. veins draining the upper surface of the gall bladder enter the liver by piercing the fossa for gall bladder.
2. veins draining the rest of the bladder form 1-2 cystic veins which either enter the liver directly or join the right branch of portal vein.

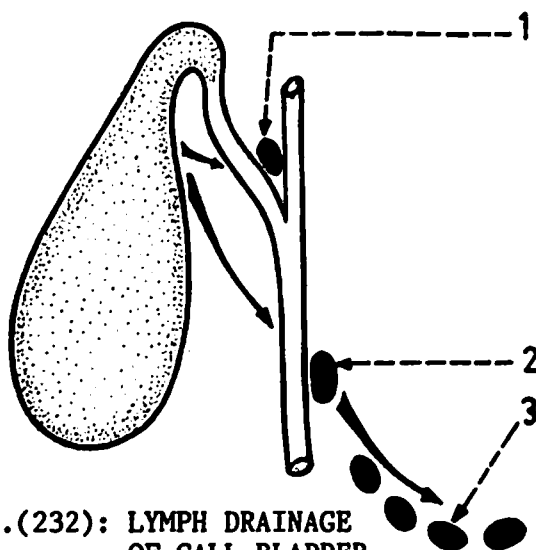


Fig.(232): LYMPH DRAINAGE OF GALL BLADDER

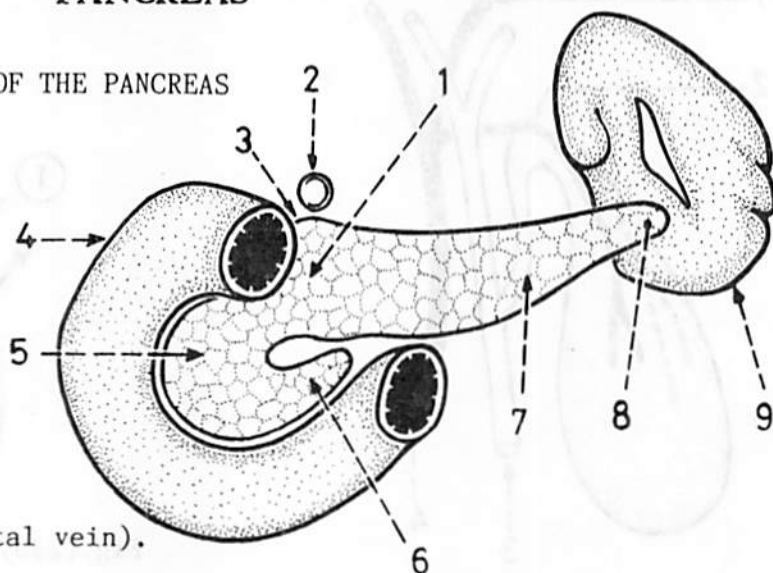
The gall bladder drains into the hepatic nodes along the hepatic artery.

1. a node close to the cystic duct.
2. a node close to the bile duct.
3. hepatic nodes along hepatic artery.

PANCREAS

Fig.(233): POSITION AND PARTS OF THE PANCREAS

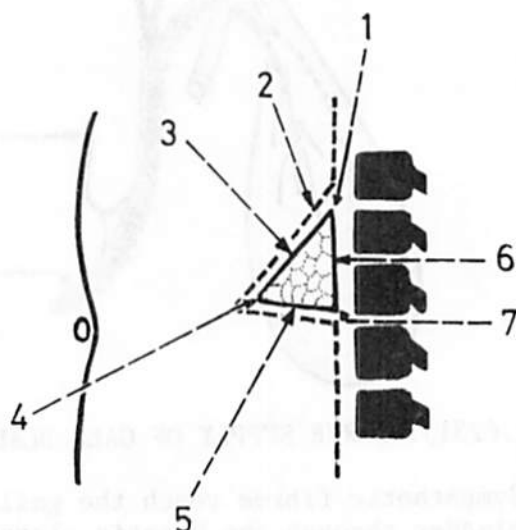
The pancreas lies in the epigastric and left hypochondriac regions extending transversely across the posterior abdominal wall from the duodenum to the spleen. The pancreas consists of a head, neck, body and tail.



1. neck of pancreas (a limited area opposite the beginning of the portal vein).
2. coeliac trunk (lies just above the omental tuberosity of the pancreas).
3. omental tuberosity of pancreas (a small projection from the upper border of the pancreas, just below the coeliac trunk).
4. duodenum (forming a C-shape around the head of the pancreas).
5. head of pancreas (the largest part, and lies in the concavity of the duodenum).
6. uncinuate process (projects upwards and to the left from the lower part of the head of pancreas).
7. body of pancreas.
8. tail of pancreas (the narrow left end).
9. spleen.

Fig.(234): SURFACES AND BORDERS OF PANCREAS (sagittal section)

The pancreas has 3 surfaces (anterior, inferior and posterior) separated by 3 borders (upper, lower and anterior). Its posterior surface lies directly on the posterior abdominal wall with no peritoneum intervening.



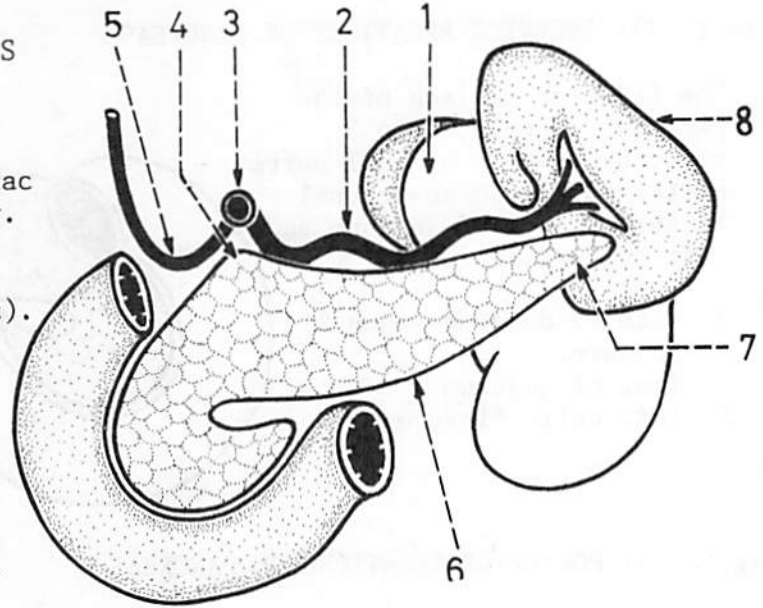
1. upper border.
2. peritoneum of posterior abdominal wall.
3. anterior surface.
4. anterior border.
5. inferior surface.
6. posterior surface.
7. lower border.

* Note that the anterior border gives attachment to the transverse mesocolon.

Fig.(235): UPPER BORDER OF PANCREAS AND ITS RELATIONS

The upper border has an upward projection just below the coeliac trunk called omental tuberosity. This border is related to 3 arteries (splenic, coeliac and beginning of the common hepatic).

1. left kidney.
2. splenic artery.
3. coeliac trunk.
4. omental tuberosity (part of the upper border).
5. common hepatic artery.
6. inferior border of pancreas.
7. tail of pancreas.
8. spleen.

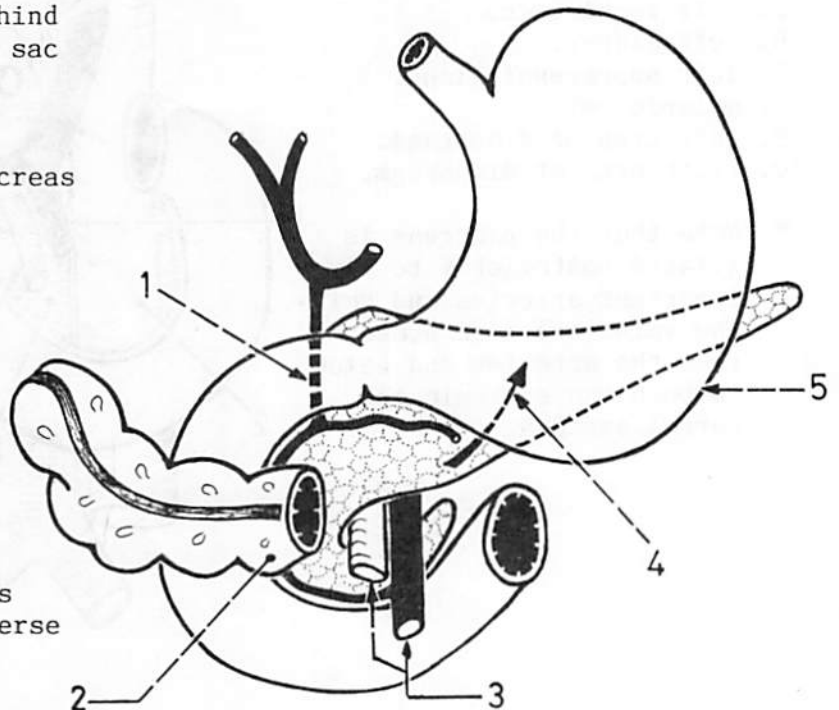


* Note that there are 2 omental tuberosities which come in contact with the lesser omentum: one for the liver and one for the pancreas.

Fig.(236): ANTERIOR RELATIONS OF PANCREAS

The anterior surface of the head is related to the gastro-duodenal artery and beginning of transverse colon. The superior mesenteric vessels cross in front of the uncinate process. The anterior surface of the body lies behind the stomach with the lesser sac in between.

1. gastro-duodenal artery.
(between the head of pancreas and superior part of the duodenum).
2. beginning of transverse colon.
3. superior mesenteric vessels (in front of the uncinate process).
4. arrow in the lesser sac between the pancreas and the stomach.
5. stomach.



* The anterior border gives attachment to the transverse mesocolon.

Fig.(237): INFERIOR RELATIONS OF PANCREAS

The inferior surface of the pancreas is related to 3 structures which are all parts of the gut: duodeno-jejunal flexure, coils of jejunum and left colic flexure.

1. site of duodeno-jejunal flexure.
2. loop of jejunum.
3. left colic flexure.

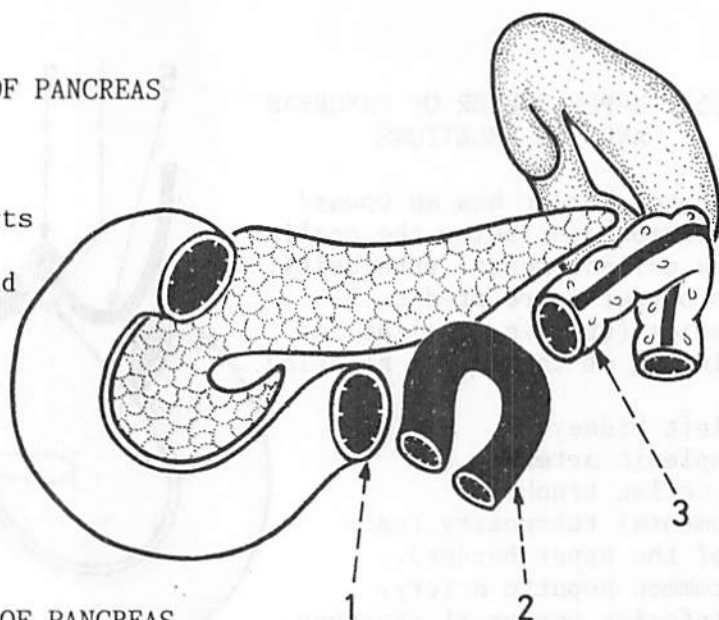


Fig.(238): POSTERIOR RELATIONS OF PANCREAS

- * Head: related posteriorly to the inferior vena cava, terminations of the 2 renal veins and right crus of diaphragm. The bile duct runs in a groove on the back of the head of the pancreas.
- * Neck: related posteriorly to the beginning of the portal vein.
- * Body: related posteriorly to the aorta, origin of superior mesenteric artery, left crus of diaphragm, left kidney, left suprarenal gland and 2 veins (splenic and left renal).

1. termination of superior mesenteric vein.
2. inferior vena cava.
3. abdominal aorta.
4. superior mesenteric artery.
5. left renal vein.
6. left kidney.
7. left suprarenal gland.
8. splenic vein.
9. left crus of diaphragm.
10. right crus of diaphragm.

- * Note that the pancreas is related posteriorly to very important arteries and veins. The veins are more numerous than the arteries and belong to both the systemic and portal systems.

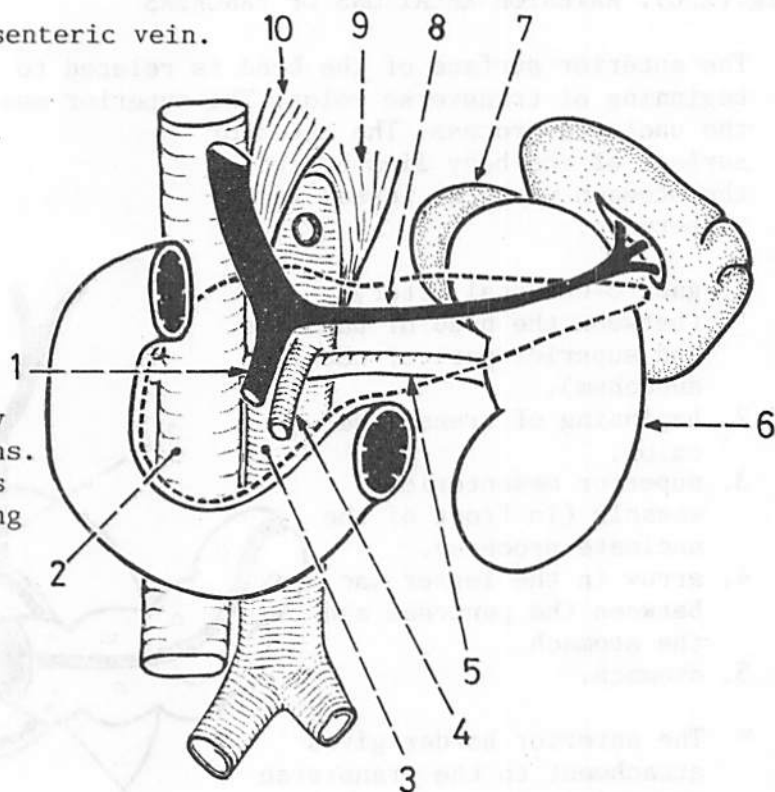
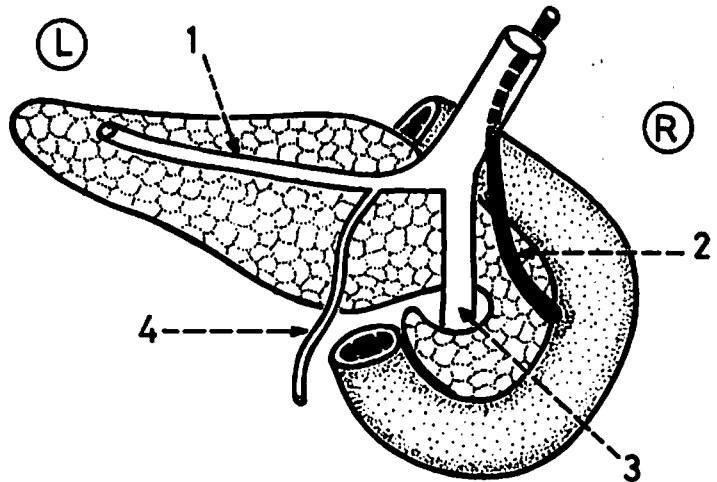


Fig.(239): POSTERIOR ASPECT OF THE PANCREAS TO SHOW THE BILE DUCT

The terminal part of the bile duct descends on the upper part of the posterior surface of the head of pancreas to reach the middle of the descending part of the duodenum. It may be embedded in the substance of the head of pancreas.



1. splenic vein.
2. bile duct on the back of the head of pancreas.
3. superior mesenteric vein.
4. inferior mesenteric vein.

* Note that the pancreas in this figure is seen from its posterior aspect.

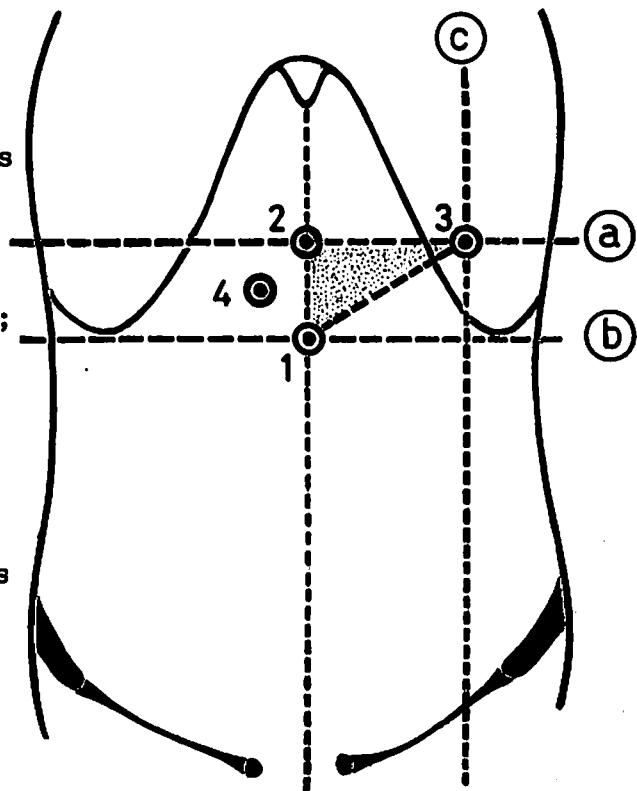
Fig.(240): SURFACE ANATOMY OF THE PANCREAS

The body of the pancreas (not the head) is represented on the surface by a triangle drawn to the left of the midline using the following 3 points:

point (1): lies at the point where the subcostal plane (b) crosses the midline, i.e. opposite L.3.

point (2): lies at the point where the transpyloric plane (a) crosses the midline, i.e. opposite L.1. This point represents the omental tuberosity.

point (3): lies at the point where the transpyloric plane (a) crosses the left lateral plane (c); this point represents the tail of pancreas.

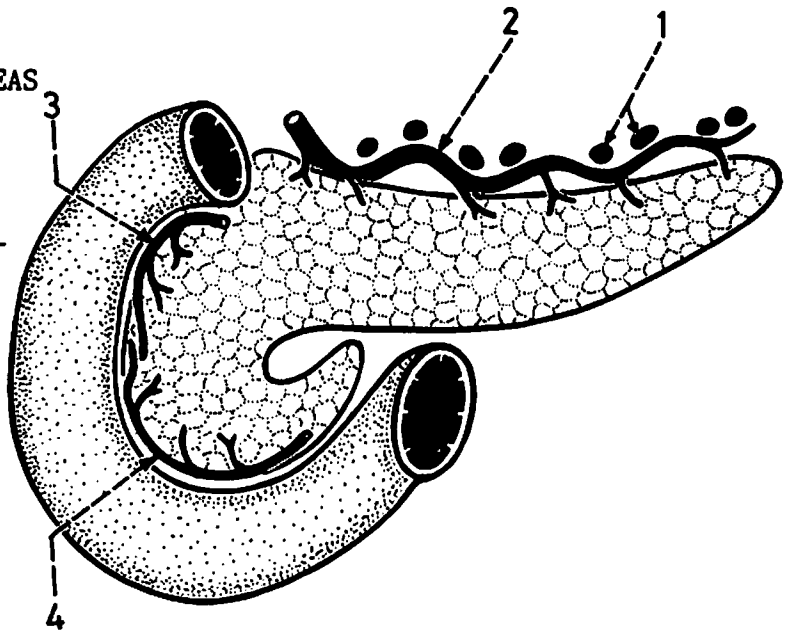


* Note that the head of the pancreas lies immediately to the right of the midline in the area between point (1) and point (2). The right extremity of the head extends about 2 inches from the midline (point 4).

Fig.(241): ARTERIES OF THE PANCREAS

the pancreas is supplied by pancreatic branches derived from the following arteries: splenic, superior pancreatico-duodenal and inferior pancreatico-duodenal.

1. pancreatico-splenic lymph nodes: a long chain along the splenic artery and upper border of the pancreas.
2. splenic artery.
3. superior pancreatico-duodenal artery (belongs to the hepatic artery).
4. inferior pancreatico-duodenal artery (a branch from the superior mesenteric artery).



* Note that most of the arterial blood to the pancreas comes from the coeliac trunk, while little blood comes from the superior mesenteric artery.

Fig.(242): DUCTS OF THE PANCREAS

The pancreas has 2 ducts (main and accessory). The main duct traverses the whole pancreas from left to right and enters the wall of the duodenum together with the bile duct where they unite together to form a dilated part called hepatopancreatic ampulla. This ampulla is surrounded by the sphincter of Oddi and opens on the summit of the major duodenal papilla in 2nd part of the duodenum. The accessory pancreatic duct is confined to the head of pancreas and runs upwards in front of the main duct to open in the 2nd part of duodenum on the summit of the minor duodenal papilla.

1. main pancreatic duct.
2. gastro-duodenal artery.
3. bile duct.
4. minor duodenal papilla.
5. major duodenal papilla.
6. descending (2nd) part of duodenum (opened).
7. accessory pancreatic duct.

* The hepato-pancreatic ampulla is also called ampulla of Vater.

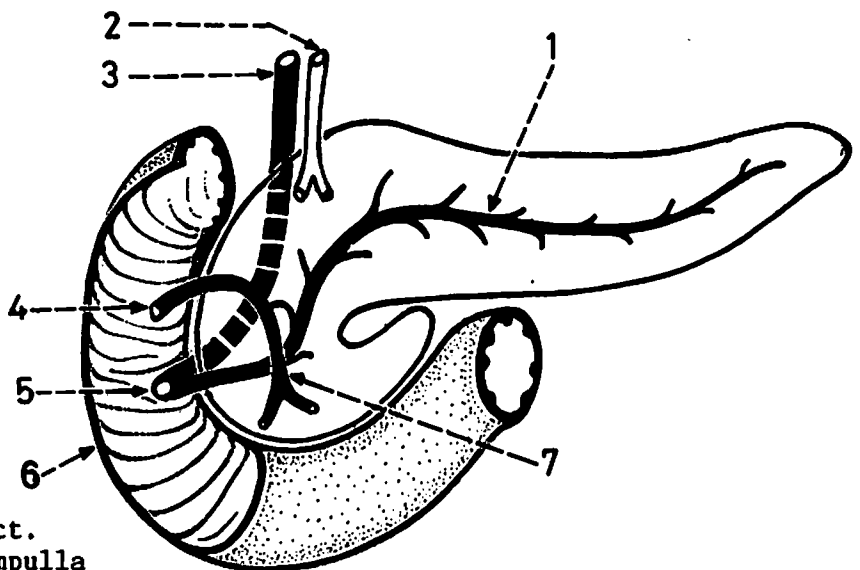
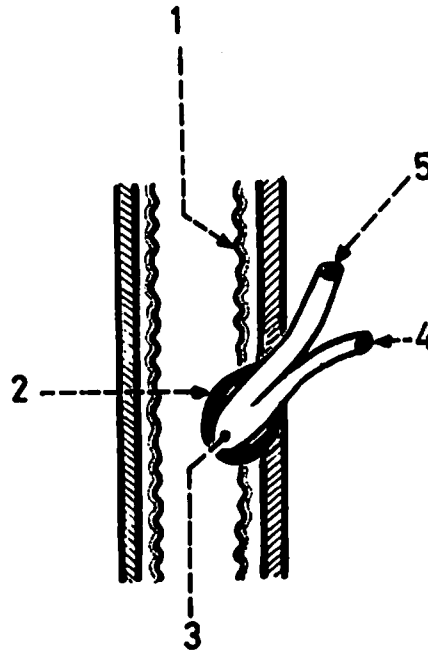


Fig.(243): HEPATO-PANCREATIC AMPULLA

The terminal part of the bile duct unites with the terminal part of the main pancreatic duct as they run obliquely in the wall of the duodenum to form a dilated part common to both tubes called hepato-pancreatic ampulla(of Vater). This ampulla is surrounded by circular smooth muscle fibres forming the sphincter of Oddi. The ampulla projects into the mucous membrane of the duodenum forming the major duodenal papilla. This papilla lies at the middle of the descending part of the duodenum on its postero-medial wall.



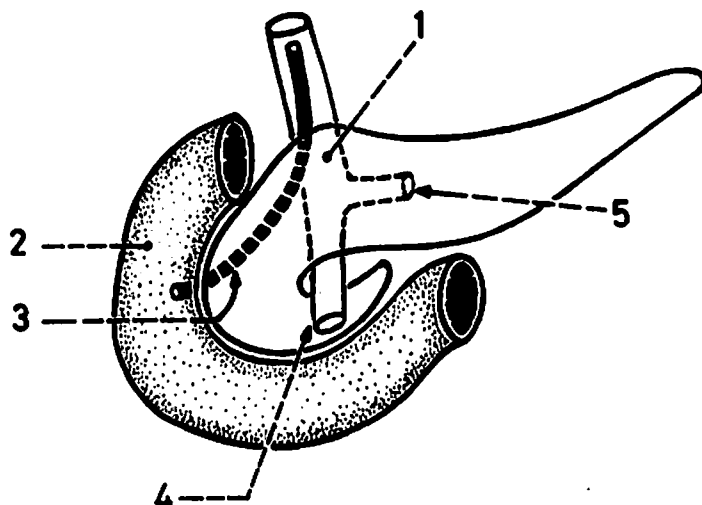
1. mucosa of the duodenum.
2. sphincter of Oddi.
3. hepato-pancreatic ampulla.
4. main pancreatic duct.
5. bile duct.

Fig.(244): STRUCTURES AFFECTED BY CANCER HEAD OF PANCREAS

Cancer head of pancreas may compress the following structures:

- * The bile duct:leading to obstructive jaundice.
- * The portal vein:leading to ascites (collection of fluid in peritoneal cavity).
- * The duodenum:leading to intestinal obstruction.

1. beginning of portal vein.
2. duodenum.
3. termination of bile duct.
4. superior mesenteric vein.
5. splenic vein.



SPLEEN

Fig.(245): POSITION OF THE SPLEEN

The spleen lies in the left hypochondrium with its long axis lying obliquely in line with the 10th rib. Its anterior (or lateral) end lies in the mid-axillary line.

1. left mid-axillary line.
2. left 9th, 10th and 11th ribs overlying the spleen.
3. spleen.
4. left colic flexure.

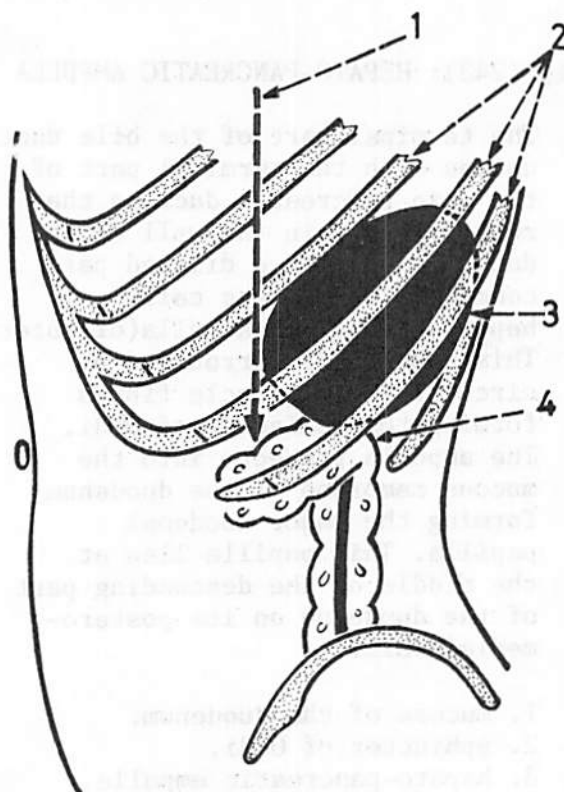


Fig.(246): SURFACES AND BORDERS OF THE SPLEEN

The spleen has 2 surfaces (diaphragmatic and visceral), 2 borders (upper and lower) and 2 ends (anterior and posterior).

1. posterior end (also called medial end; it is rounded and is directed towards the vertebral column opposite the 10th T.V.).
2. visceral surface (is concave, shows the hilum, and is related to the abdominal viscera).
3. lower border (more rounded than the superior border).
4. hilum of the spleen (a long fissure on the visceral surface).
5. anterior end (also called lateral end; it is expanded like a border).
6. notches on the upper border near the anterior end.
7. upper border (is marked by the notches near the anterior end of the spleen).

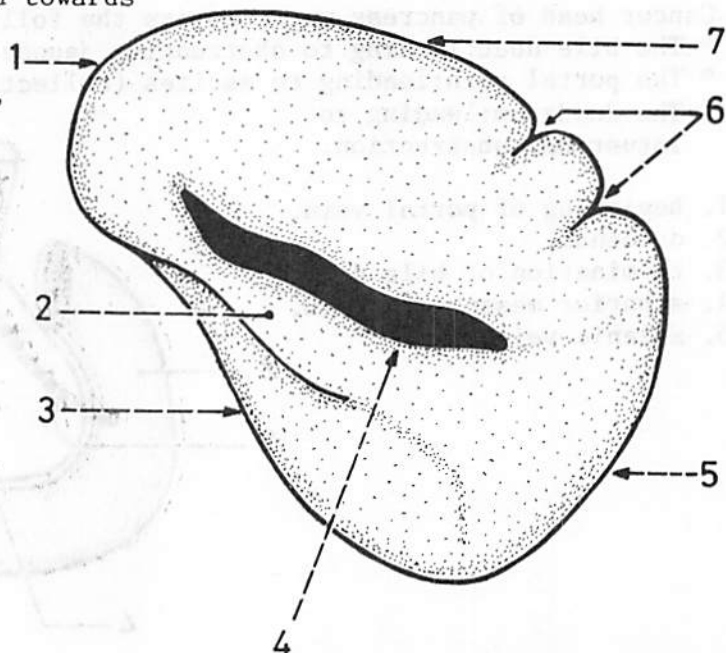


Fig.(247): IMPRESSIONS ON THE VISCERAL SURFACE OF THE SPLEEN

The visceral surface of the spleen shows 4 impressions: gastric, colic, renal and pancreatic.

1. gastric impression (a wide concave area above the hilum for the posterior surface of the stomach),
2. hilum of the spleen (intervenes between the gastric and the renal impressions).
3. renal impression (lies below the hilum and is separated from the gastric impression by a raised ridge; it is related to the upper part of the left kidney).
4. colic impression (lies between the hilum and the anterior border and is related to the left colic flexure).
5. pancreatic impression (a small rounded area situated just below the anterior end of the hilum and behind the colic impression; it is related to the tail of pancreas).

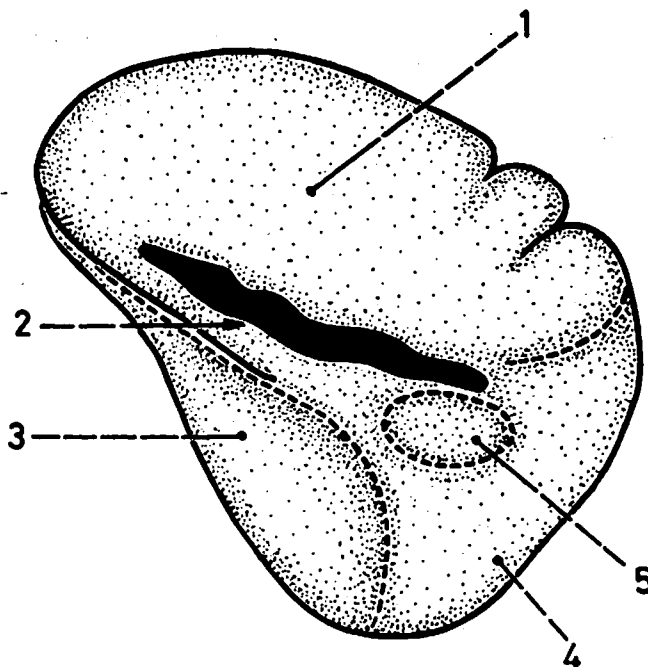


Fig.(248): RELATIONS OF THE VISCERAL SURFACE OF THE SPLEEN

The visceral surface of the spleen is related to the posterior surface of the stomach, upper part of left kidney, tail of pancreas and left colic flexure.

1. upper part of left kidney.
2. upper border of the spleen.
3. area for the stomach (gastric impression).
4. left colic flexure.
5. tail of pancreas.
6. splenic artery.

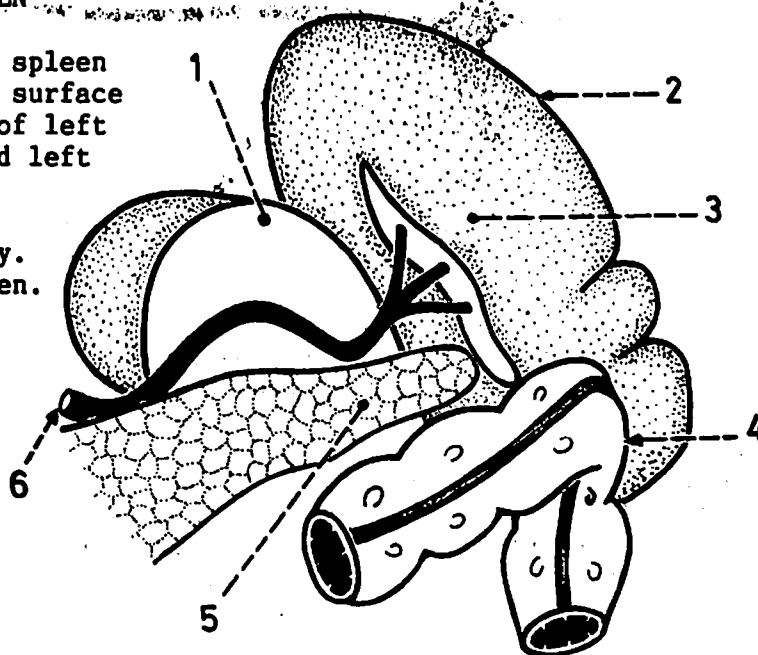


Fig.(249): RELATIONS OF THE DIAPHRAGMATIC SURFACE (coronal section)

The diaphragmatic surface is convex and is related to the diaphragm from which it is separated by the greater sac. The diaphragm separates the spleen from the left lung and pleura.

1. spleen surrounded by peritoneum.
2. gastrosplenic ligament.
3. lieno-renal ligament.
4. diaphragm.
5. left costo-diaphragmatic recess.
6. left lung.
7. chest wall.
8. greater sac.
9. diaphragmatic surface of spleen.

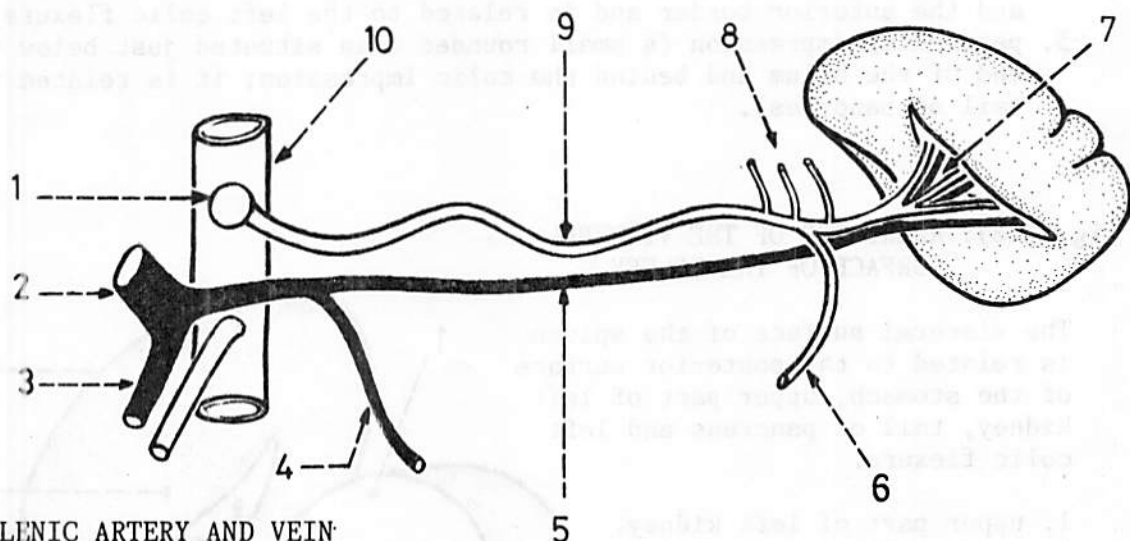
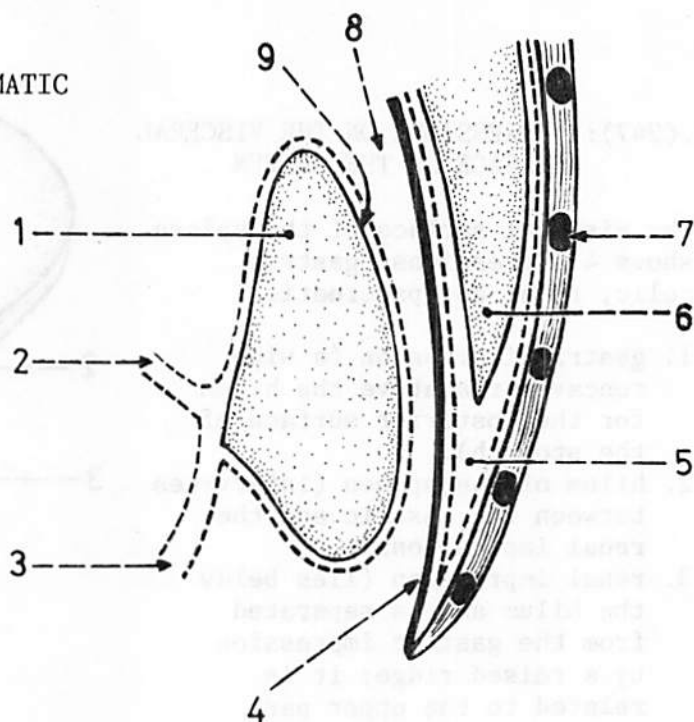


Fig.(250): SPLENIC ARTERY AND VEIN

The splenic artery is a branch of the coeliac trunk and runs transversely in a wavy course to reach the spleen. The splenic vein runs just below the artery in a straight course to join the superior mesenteric vein and form the portal vein.

- | | |
|--------------------------------|---------------------------------|
| 1. coeliac trunk (from aorta). | 6. left gastro-epiploic artery. |
| 2. beginning of portal vein. | 7. terminal splenic branches. |
| 3. superior mesenteric vein. | 8. short gastric arteries. |
| 4. inferior mesenteric vein. | 9. splenic artery. |
| 5. splenic vein. | 10. abdominal aorta. |

Fig.(251): PERITONEAL RELATIONS OF THE SPLEEN

The spleen has 2 ligaments attached to its hilum: gastrosplenic ligament (to stomach) and lienorenal ligament (to left kidney). It is completely covered by peritoneum.

1. lesser sac.
2. lienorenal ligament.
3. splenic artery.
4. left kidney.
5. stomach.
6. gastrosplenic ligament.
7. diaphragmatic surface of spleen.
8. greater sac (surrounds the spleen completely except at the hilum where the splenic recess of the lesser sac comes in contact with it).

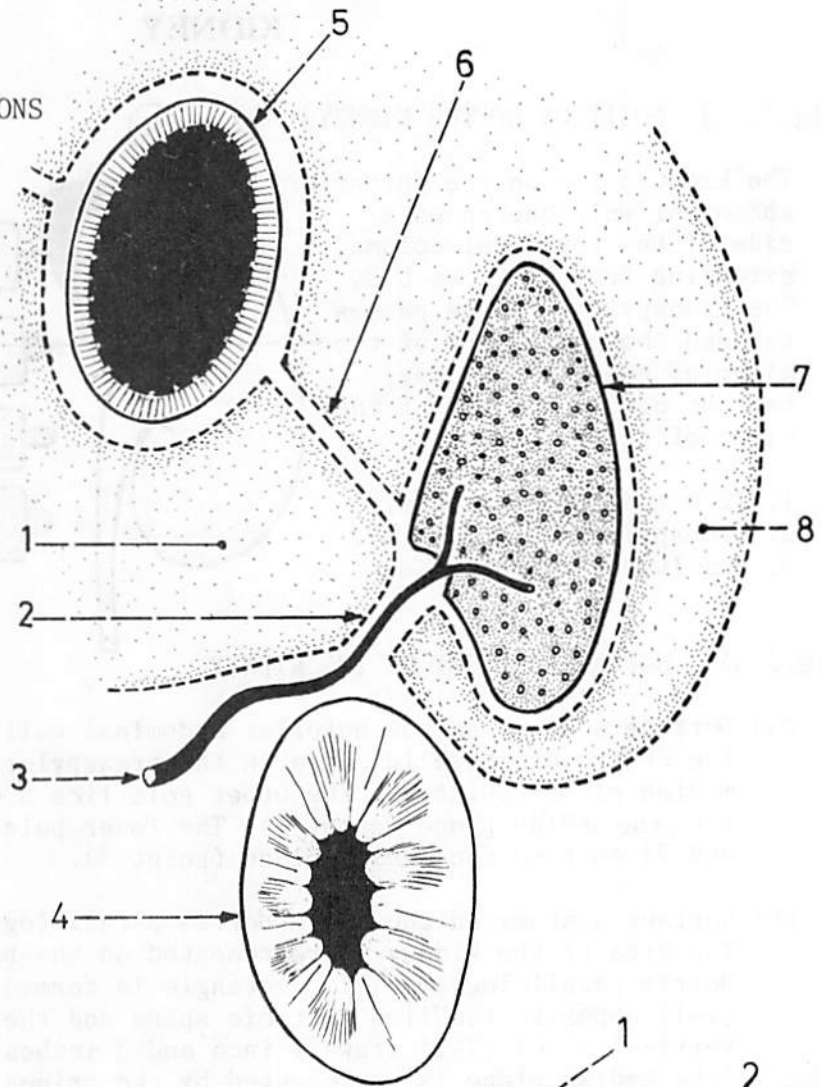
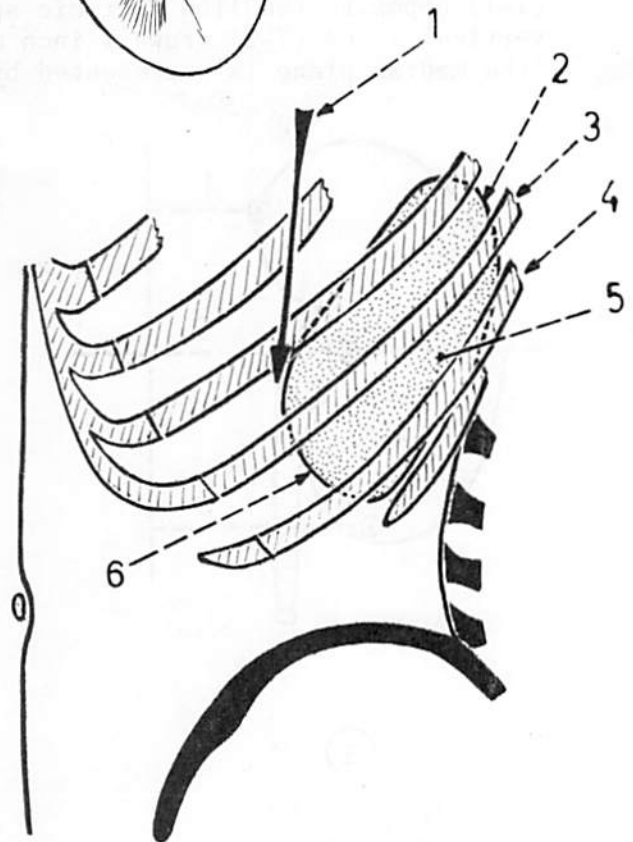


Fig.(252): SURFACE ANATOMY OF THE SPLEEN

The spleen can be represented on the surface of the left hypochondrium by an area corresponding to the left 9, 10, 11 ribs. The anterior end of the spleen reaches the mid-axillary line, while its posterior end reaches about 2 inches from the spines of the vertebrae.

1. mid-axillary line.
2. posterior end of the spleen.
3. 10th rib.
4. 11th rib.
5. spleen.
6. anterior end of the spleen.



KIDNEY

Fig.(253): POSITION OF THE KIDNEYS

The kidneys lie on the posterior abdominal wall one on each side of the vertebral column, extending from T.12 to L.3. The transpyloric plane passes through the upper part of the hilum of the right kidney, but through the centre of the hilum of the left kidney.

1. 12th thoracic vertebra.
2. transpyloric plane (L.1).
3. 3rd lumbar vertebra.

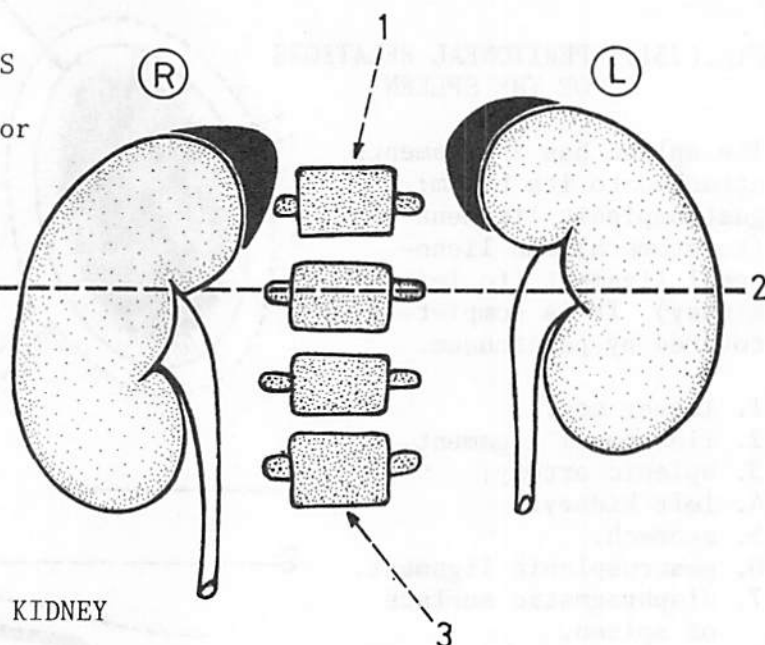


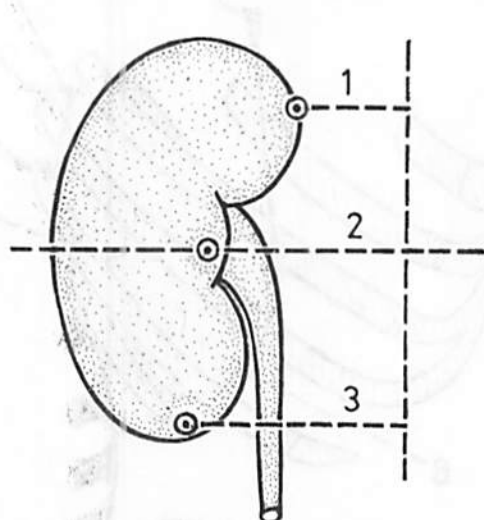
Fig.(254): SURFACE ANATOMY OF THE KIDNEY

- (a) Surface anatomy on the anterior abdominal wall:

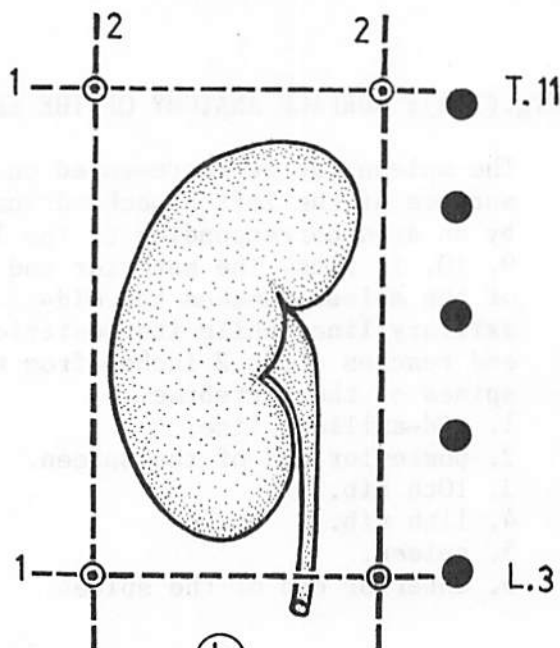
The centre of the hilum lies in the transpyloric plane, 5 cm from the median plane (point 2). The upper pole lies 5 cm above the hilum and $2\frac{1}{2}$ cm from the median plane (point 1). The lower pole lies 5 cm below the hilum and $7\frac{1}{2}$ cm from the median plane (point 3).

- (b) Surface anatomy on the back (Morris parallelogram):

The area of the kidney is represented on the back by a rectangle called Morris parallelogram. This rectangle is formed by 2 horizontal lines (1-1) opposite the 11th thoracic spine and the 3rd lumbar spine, and 2 vertical lines (2-2) drawn 1 inch and 3 inches from the median plane (the median plane is represented by the spines of the vertebrae).



(a)



(b)

Fig.(255): ANTERIOR RELATIONS OF RIGHT KIDNEY

The anterior surface of the right kidney is related to: right suprarenal gland, right lobe of liver, descending part of duodenum, right colic flexure, ascending branch of right colic artery and coils of jejunum in front of this artery.

1. area for right lobe of liver (extends over the upper 2/3 of the anterior surface).
2. right colic flexure (in front of the lateral part of the lower 1/3 of the anterior surface).
3. area covered by coils of jejunum (extends over the medial part of the lower 1/3 of the anterior surface).
4. ascending branch of right colic artery (ascends in front of the lower end).
5. descending part of duodenum (covers a narrow area close to the hilum).
6. right suprarenal gland (covers the upper end of the kidney).

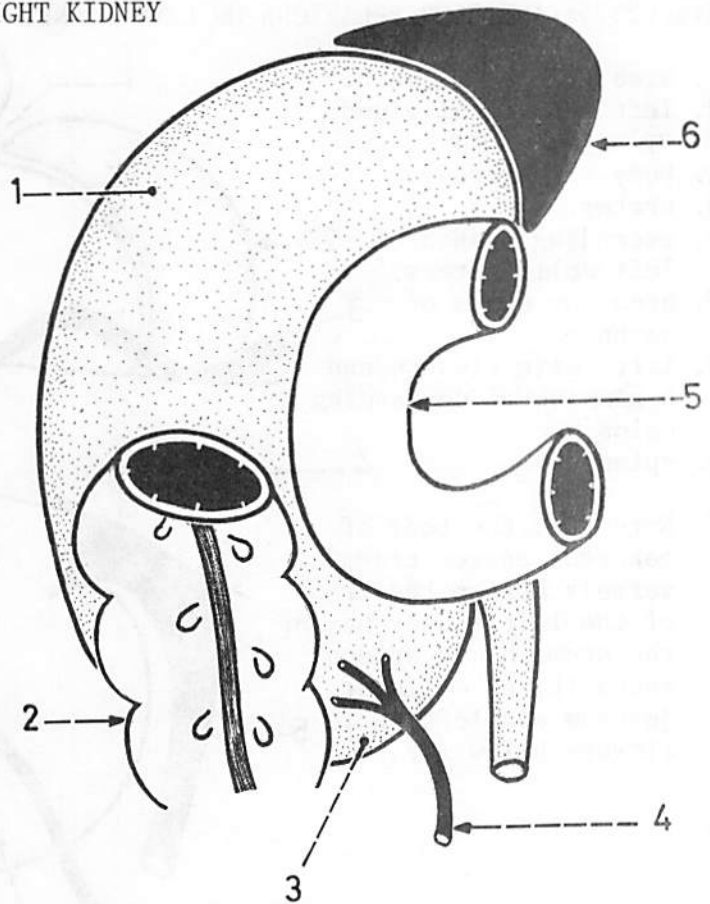


Fig.(256): PERITONEAL RELATIONS OF THE ANTERIOR SURFACE OF RIGHT KIDNEY

The anterior surface of the right kidney shows areas covered with peritoneum and areas devoid of it. The areas covered with peritoneum are that for the liver and that for the jejunal loops, while the areas not covered are those for the suprarenal gland, right colic flexure and duodenum.

1. area for right suprarenal gland.
2. area for right lobe of liver.
3. area for right colic flexure.
4. area for coils of jejunum.
5. area for descending part of duodenum.

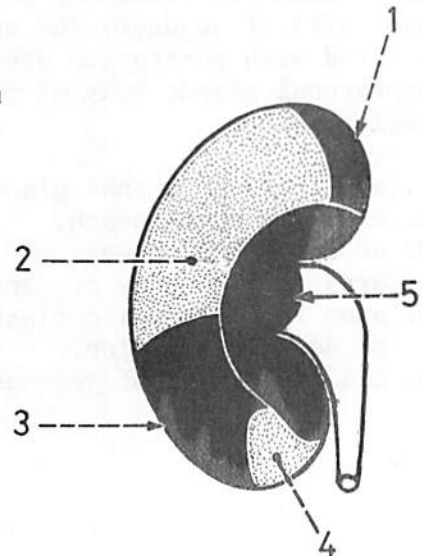


Fig.(257): ANTERIOR RELATIONS OF LEFT KIDNEY

1. area for the stomach.
2. left suprarenal gland.
3. splenic artery.
4. body of pancreas.
5. ureter.
6. ascending branch of left colic artery.
7. area for coils of jejunum.
8. left colic flexure and beginning of descending colon.
9. spleen.

* Note that the body of pancreas passes transversely across the front of the left kidney having the stomach and spleen above it, and coils of jejunum and left colic flexure below it.

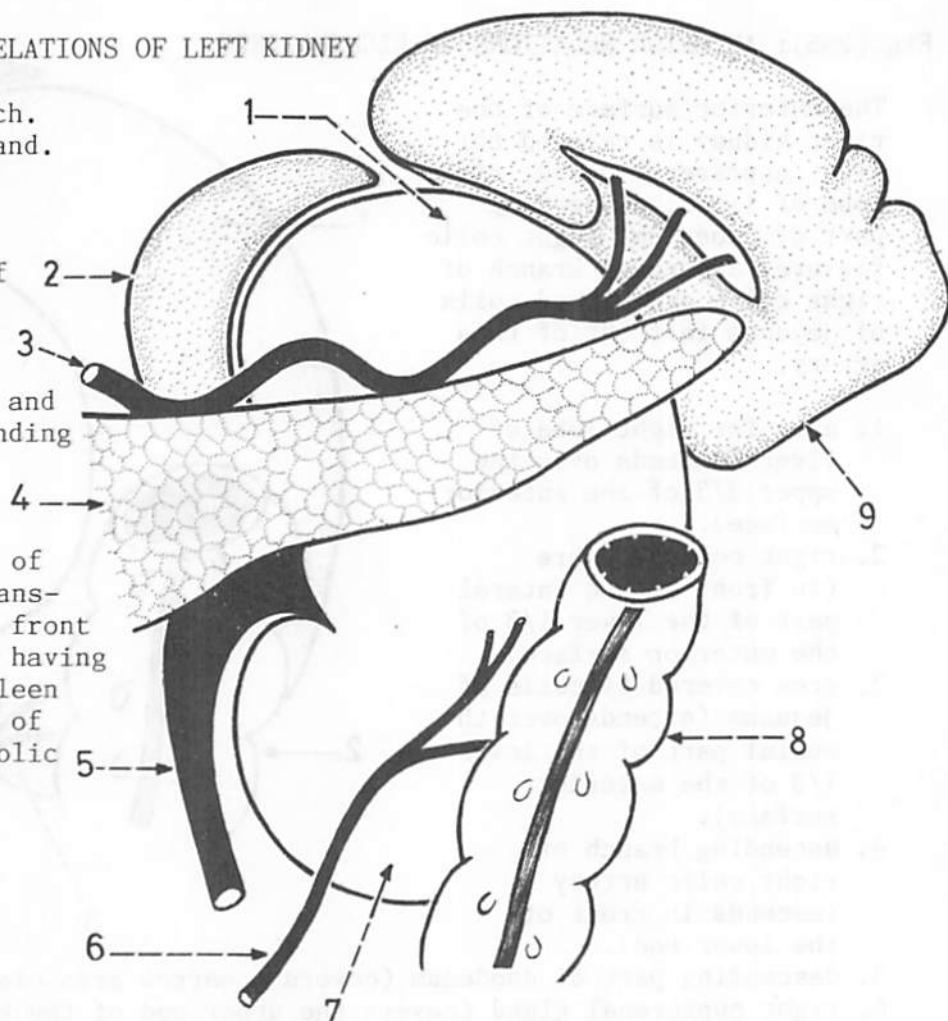


Fig.(258): PERITONEAL RELATIONS OF THE ANTERIOR SURFACE OF LEFT KIDNEY

The areas of the anterior surface covered with peritoneum are those for the stomach, spleen and coils of jejunum. The areas which are not covered with peritoneum are those for the left suprarenal gland, body of pancreas and left colic flexure.

1. area for suprarenal gland.
2. area for the stomach.
3. area for the spleen.
4. area for the body of pancreas.
5. area for left colic flexure and the beginning of descending colon.
6. area for coils of jejunum.

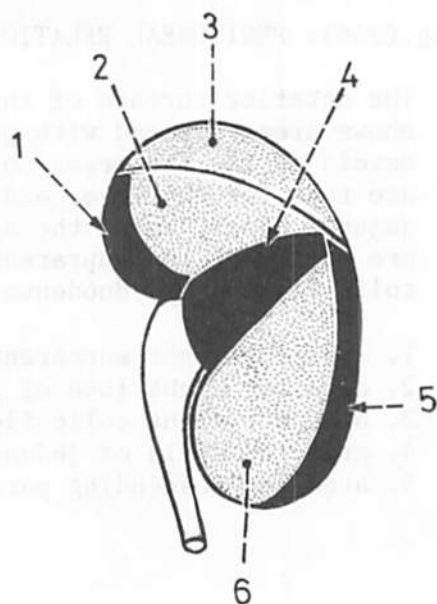


Fig.(259-A): MUSCLES POSTERIOR TO LEFT
AND RIGHT KIDNEYS

The right and left kidneys differ in their anterior relations but have the same posterior relations. These posterior relations consist of muscles as well as vessels and nerves; these muscles are the diaphragm, psoas major, quadratus lumborum and origin of transversus abdominis.

(a) Back of left kidney.

(b) Back of right kidney.

1. area related to diaphragm (upper part of the posterior surface).
2. hilum of the kidney.
3. area related to psoas major (a vertical area close to the hilum).
4. area for quadratus lumborum (a vertical area in the middle of the lower part of the posterior surface).
5. area related to the origin of transversus abdominis (a narrow vertical area close to the lateral border).

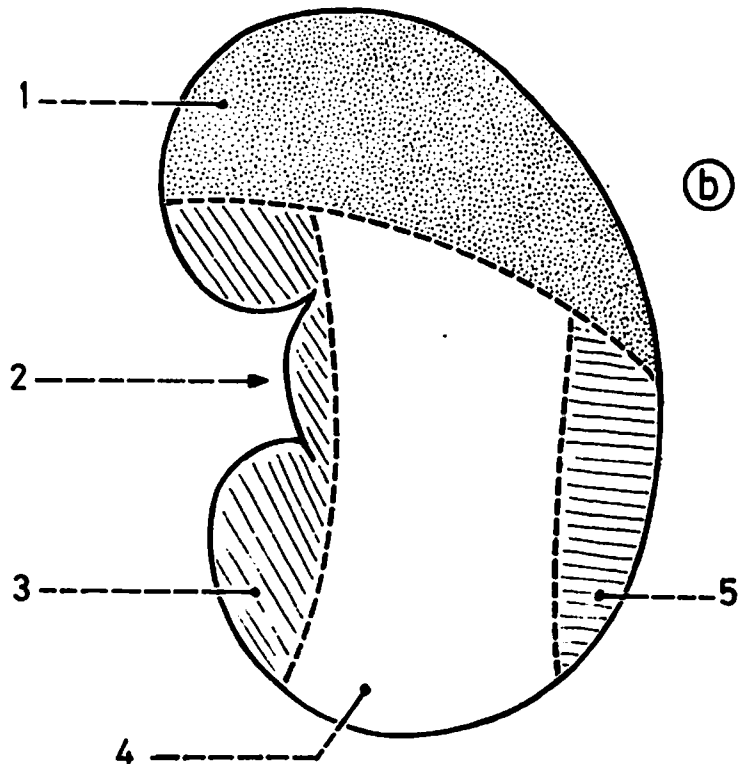
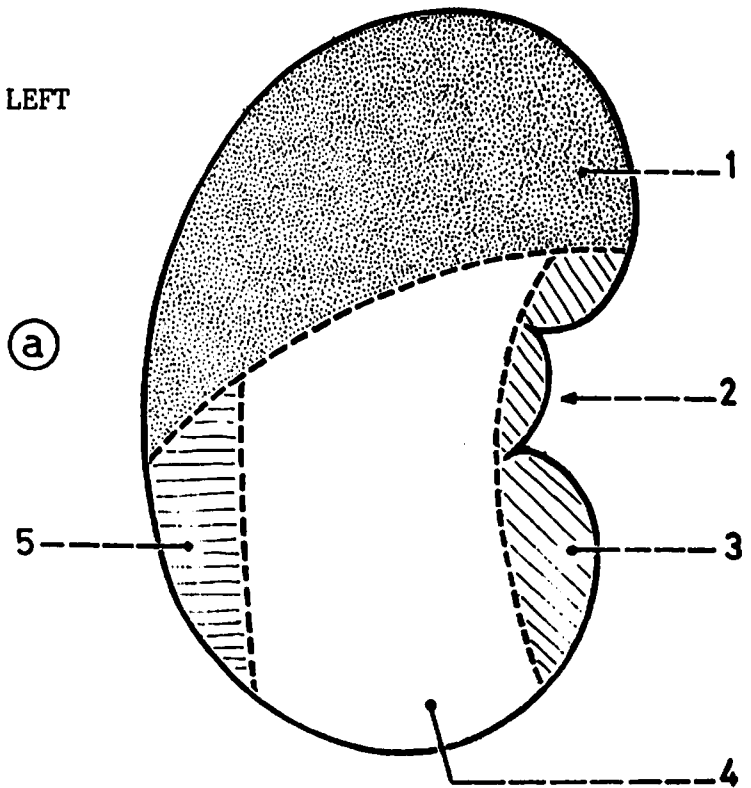


Fig.(259-B): NERVES AND VESSELS POSTERIOR TO THE KIDNEY

These are the subcostal vessels, subcostal nerve, iliohypogastric nerve and ilio-inguinal nerve; they are the same behind both kidneys.

1. costo-diaphragmatic recess of the pleura.
2. subcostal vessel.
3. subcostal nerve.
4. iliohypogastric nerve.
5. ilio-inguinal nerve.
6. kidney (in section).
7. peritoneum on the front of the kidney.
8. diaphragm behind the upper part of the kidney and separating it from the costo-diaphragmatic recess.

* The diaphragm may be deficient in its lower part behind the kidney (at the lumbo-costal triangle), and in such a case the kidney comes in direct contact with the pleura.

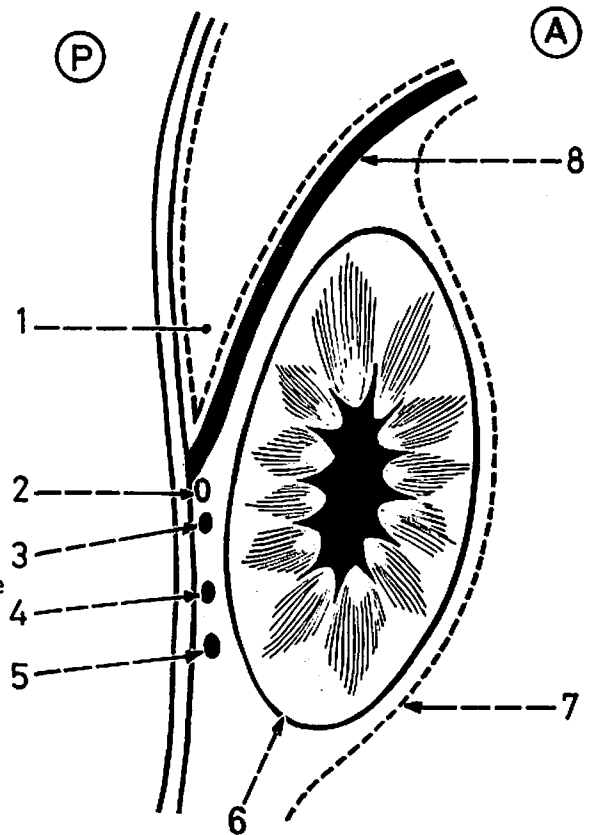


Fig.(260): COVERINGS OF THE KIDNEY

The kidney is covered by several layers of fibrous and fatty tissues; these are the fibrous capsule, perirenal fat, renal fascia and pararenal fat (from within outwards).

1. perirenal (perinephric) fat (surrounds both the kidney and the suprarenal gland).
2. pararenal fat (a large mass of fat which lies mainly behind the kidney).
3. renal fascia (a condensed fibro-areolar tissue which consists of anterior and posterior layers; these 2 layers are continuous together above the kidney and the suprarenal gland but are separate below).
4. suprarenal gland.
5. peritoneum.
6. fibrous capsule of the kidney.
7. the kidney (in section).
8. anterior layer of the renal fascia.

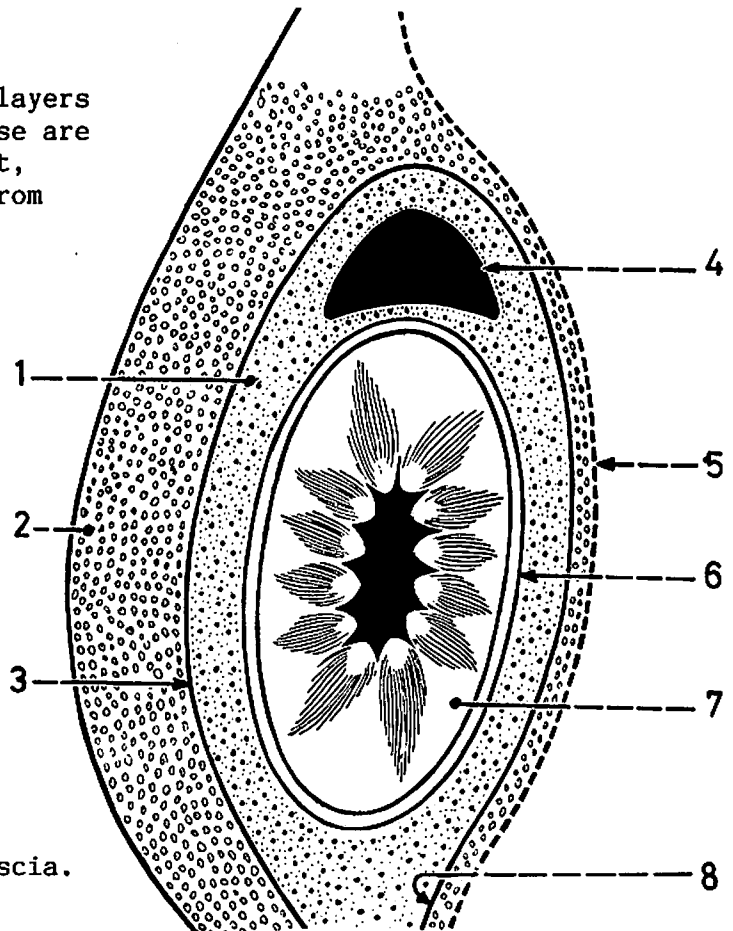
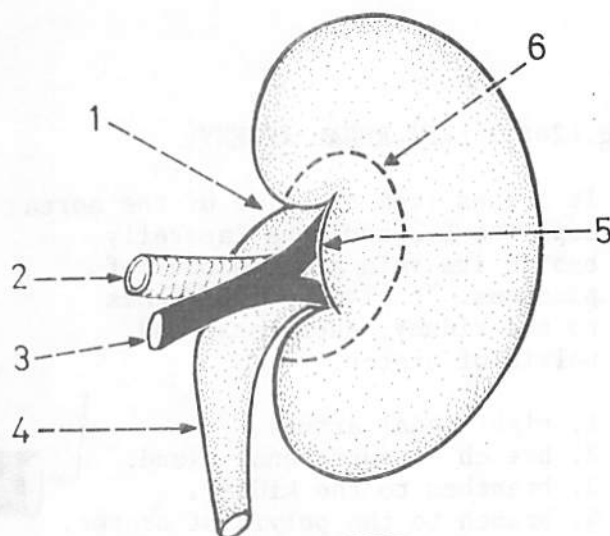


Fig.(261): STRUCTURES PASSING THROUGH THE HILUM OF THE KIDNEY

The hilum lies in the central concave part of the medial border of the kidney and leads to a wide space inside the kidney called renal sinus. The hilum transmits the renal vein, renal artery and pelvis of the ureter (from before backwards).

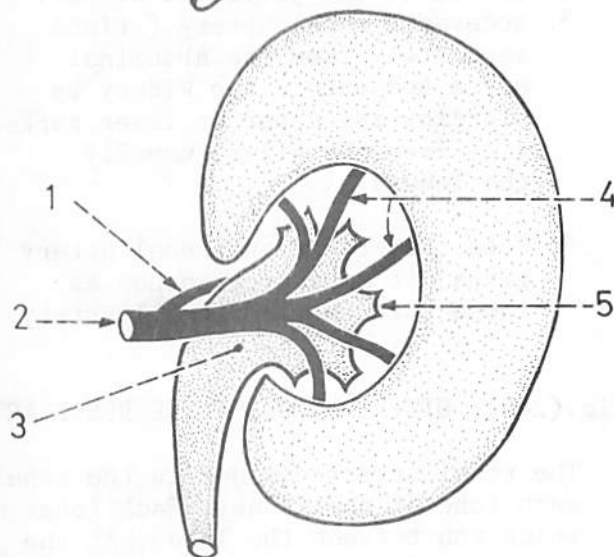


1. pelvis of ureter.
2. renal artery.
3. renal vein.
4. beginning of the ureter.
5. hilum of the kidney.
6. outline of the renal sinus.

* Note that the pelvis of the ureter is always directed towards the lower end of the kidney.

Fig.(262): STRUCTURES INSIDE THE RENAL SINUS

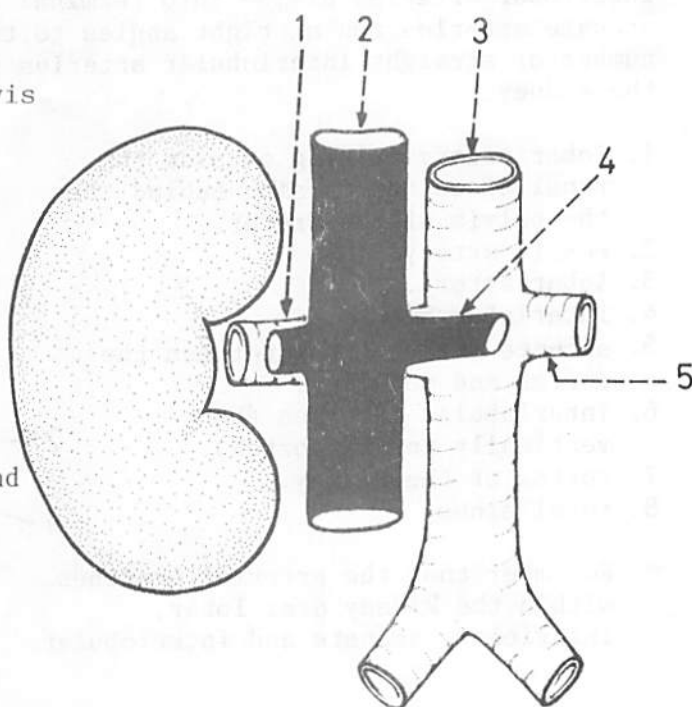
These are the pelvis of the ureter and its calyces (major and minor) in addition to the lobar arteries and accompanying veins.



1. one of the lobar arteries which enters the hilum behind the pelvis of ureter.
2. renal artery.
3. pelvis of ureter.
4. lobar arteries (in front of the pelvis of ureter).
5. minor calyx.

Fig.(263): RIGHT RENAL ARTERY

It arises from the aorta opposite L.2 and runs behind its own vein and inferior vena cava.

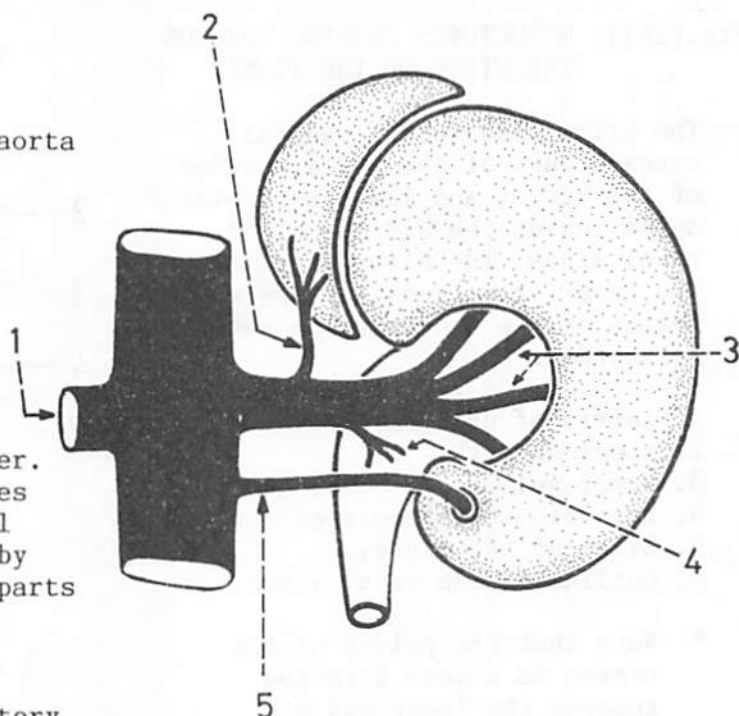


1. right renal artery.
2. inferior vena cava.
3. abdominal aorta.
4. left renal vein.
5. left renal artery.

Fig.(264): LEFT RENAL ARTERY

It arises from the side of the aorta opposite L.2 and runs laterally behind its vein and the body of pancreas. It gives off branches to the kidney, suprarenal and pelvis of ureter.

1. right renal artery.
2. branch to suprarenal gland.
3. branches to the kidney.
4. branch to the pelvis of ureter.
5. accessory renal artery (arises separately from the abdominal aorta and enters the kidney by piercing its upper or lower parts away from the hilum, usually the lower).

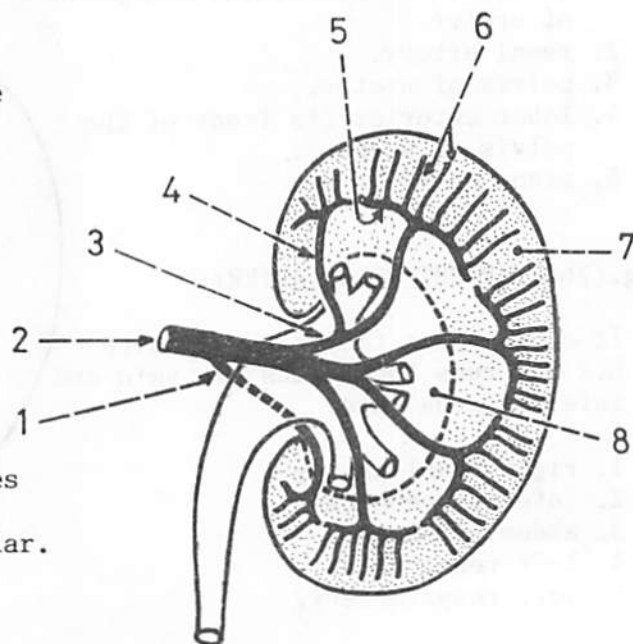


* Note that the right renal artery gives off similar branches as those of the left renal artery.

Fig.(265): DISTRIBUTION OF THE RENAL ARTERY WITHIN THE KIDNEY

The renal artery divides in the renal sinus into 4-5 lobar arteries, one for each lobe of the kidney. Each lobar artery divides into 2 interlobar arteries which run between the lobes. At the junction between the cortex and medulla the interlobar arteries divide into terminal branches called arcuate arteries. The arcuate arteries run at right angles to the parent stem and give off a large number of straight interlobular arteries which pass vertically to the surface of the kidney.

1. lobar artery arising outside the renal sinus and passing behind the the pelvis of the ureter.
2. renal artery.
3. lobar artery.
4. interlobar artery.
5. arcuate artery (runs between the cortex and medulla).
6. interlobular arteries (run vertically in the cortex).
7. cortex of the kidney.
8. renal sinus.



* Remember that the arterial branches within the kidney are: lobar, interlobar, arcuate and interlobular.

Fig.(266): RENAL LOBES AND RELATED ARTERIES

The lobe of the kidney consists of the renal pyramid and the area of the cortex overlying its base. The apex of the pyramid projects into the renal sinus and forms the renal papilla. The parts of the renal cortex which dip into the renal medulla between the pyramids are called renal columns.

1. lobar artery (in the renal sinus).
2. renal column.
3. renal pyramid.
4. area of the cortex belonging to a renal lobe.
5. arcuate artery and its interlobular branches.
6. outline of a renal lobe.
7. arcuate artery.
8. interlobular arteries.
9. interlobar artery (between 2 adjacent lobes).

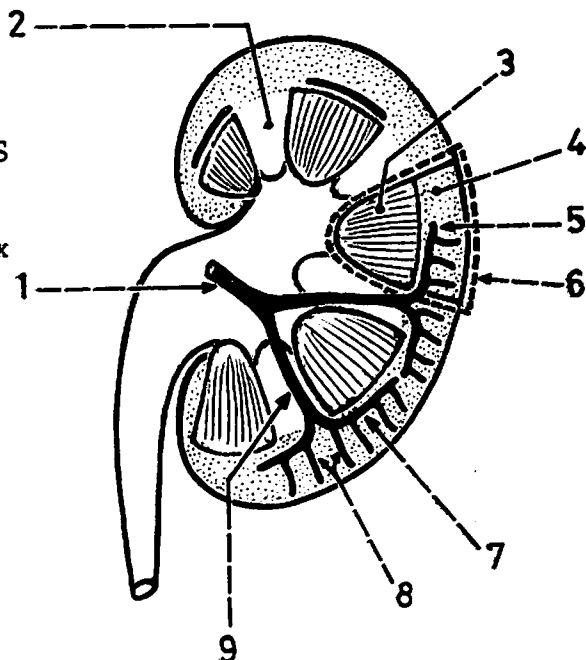


Fig.(267): BLOOD CIRCULATION INSIDE THE KIDNEY

The interlobular arteries are the source of all the afferent arteries of the glomeruli. The efferent arteries of the glomeruli convey their blood to the interlobular veins.

1. cortical glomerulus.
2. arterial capillaries from the efferent artery of glomerulus.
3. venous capillaries leading to the interlobular vein.
4. interlobular vein.
5. arcuate artery.
6. arcuate vein.
7. interlobar artery.
8. interlobar vein.
9. straight venules in the medulla.
10. straight arterioles in the medulla.
11. juxta-medullary glomerulus.
12. interlobular artery.
13. afferent artery to glomerulus.

* The lobar arteries are end-arteries.

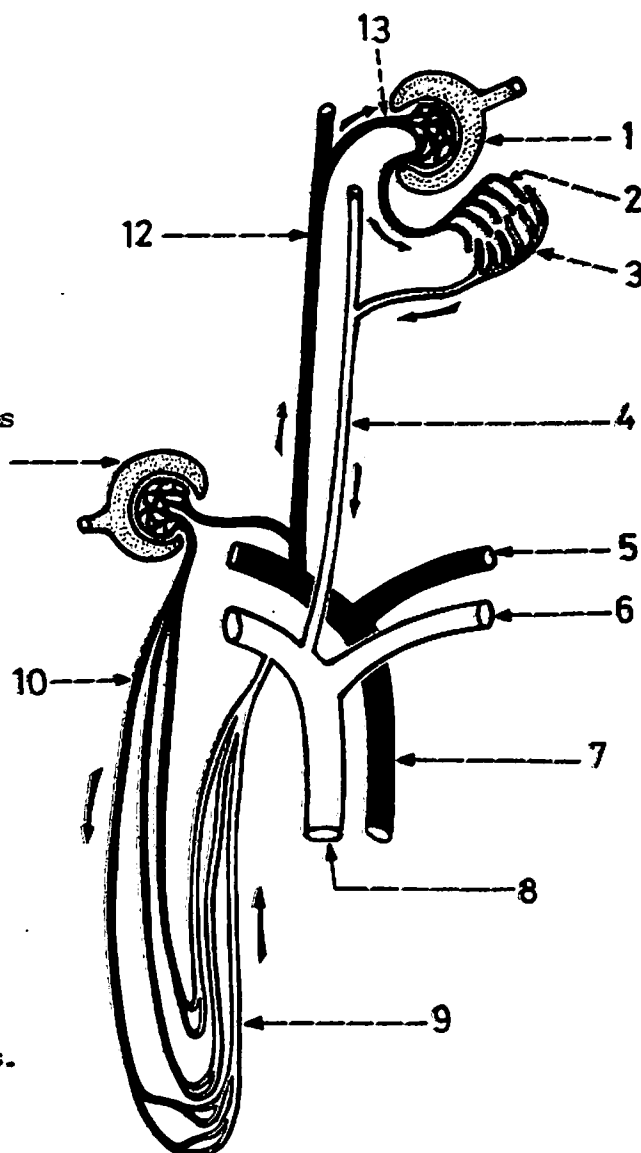
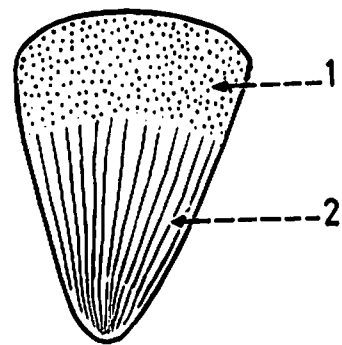


Fig.(268): RENAL LOBE

A renal lobe is conical in shape with its apex directed inwards towards the hilum where it forms the prominent renal papilla, while its base is directed outwards towards the surface of the kidney. It consists of 2 parts: a medullary part called the pyramid and is formed of collecting tubules, and a cortical part at the base of the lobe and is formed mainly of glomeruli and related tubules.



1. cortical part of the renal lobe.
2. pyramid.

Fig.(269): PELVIS OF THE URETER AND ITS CALYCES (L.S. in the coronal plane)

The pelvis of the ureter lies partly inside the renal sinus and partly outside it. Within the renal sinus it divides into 2-3 major calyces each of which divides into several minor calyces. Each minor calyx receives the tips of 1-3 renal papillae.

1. major calyx (superior).
2. pelvis of the ureter.
3. beginning of the ureter.
4. major calyx (inferior).
5. minor calyces.
6. renal sinus.
7. renal papillae.
8. outline of renal sinus.

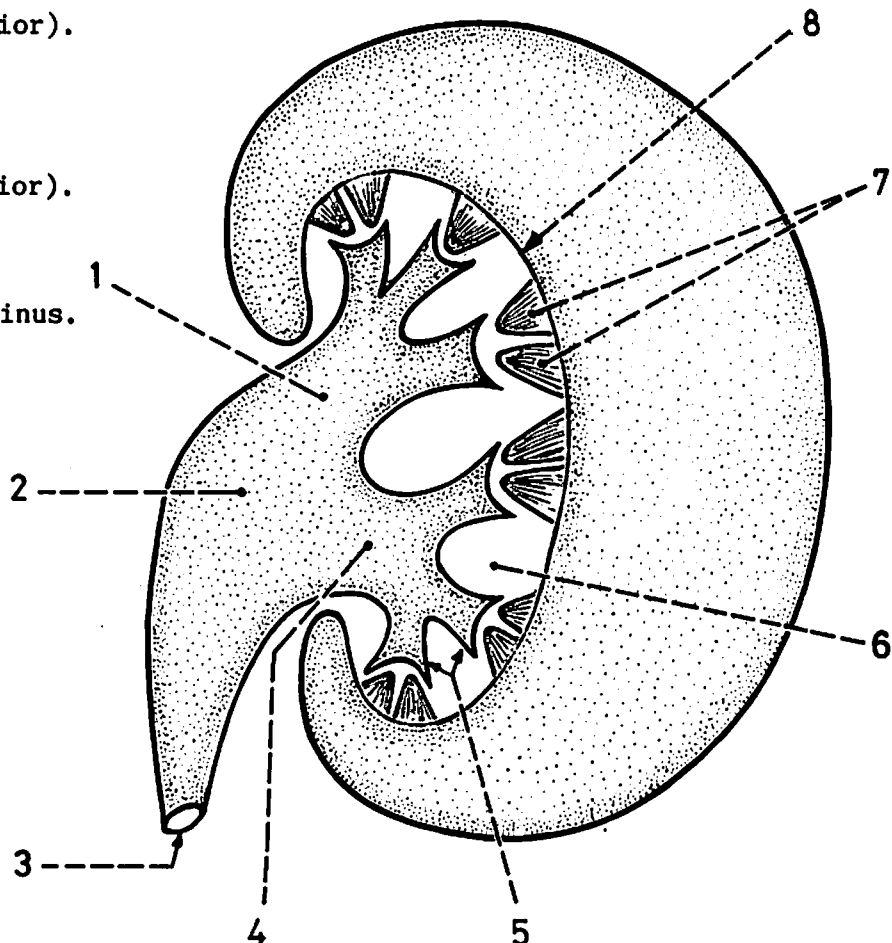


Fig.(270): LEFT RENAL VEIN

It is 3 times longer than the right vein. It passes behind the body of the pancreas and crosses in front of the aorta just below the superior mesenteric vein to end in the inferior vena cava. It receives the left gonadal vein and left suprarenal vein.

1. inferior vena cava.
2. superior mesenteric artery.
3. left suprarenal vein.
4. left gonadal vein (testicular or ovarian).
5. left renal vein.

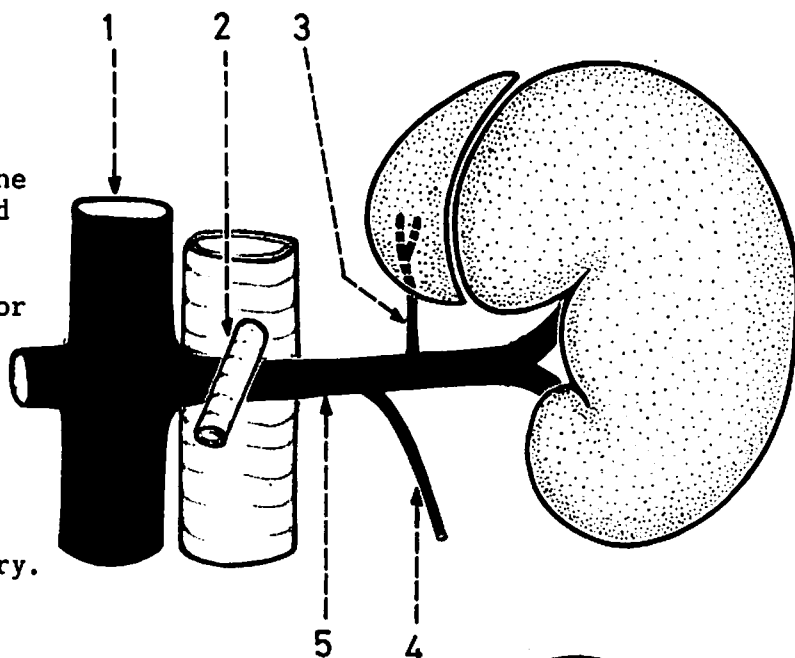


Fig.(271): RENAL PLEXUS OF NERVES

The renal plexus surrounds the renal artery and gets its fibres from the coeliac plexus, aortic plexus and the lowest thoracic splanchnic nerve. The fibres of the renal plexus are sympathetic.

1. arrow indicating the lowest thoracic splanchnic nerve.
2. coeliac plexus.
3. aortic plexus.
4. renal plexus.

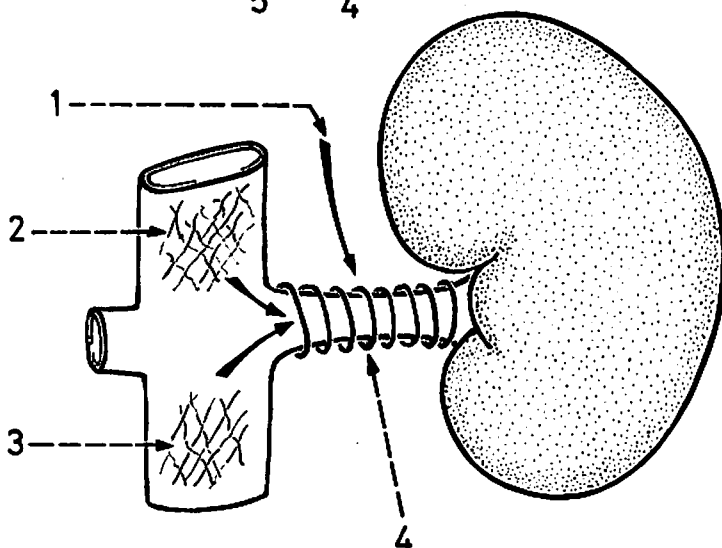
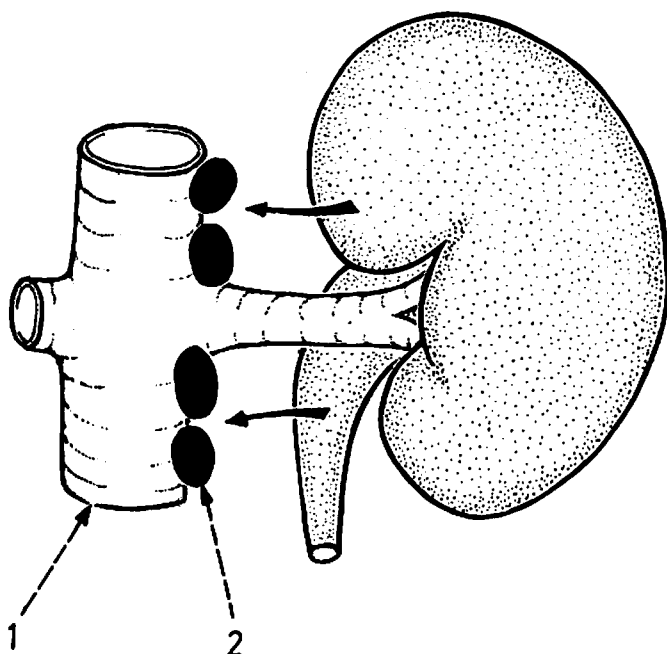


Fig.(272): LYMPHATIC DRAINAGE OF THE KIDNEY

The lymph vessels begin inside the kidney tissue and come out through the hilum to end in the lateral aortic lymph nodes situated close to the origin of the renal artery.

1. abdominal aorta.
2. lateral aortic nodes (on the side of the aorta).



URETER

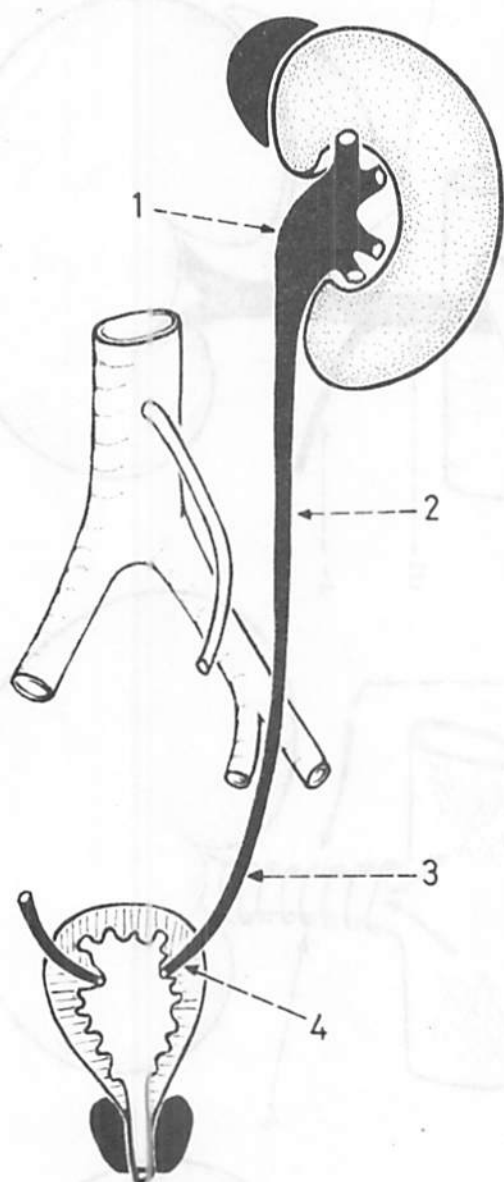


Fig.(273): PARTS OF THE URETER

The ureter begins by a dilated part called pelvis of ureter. It has an abdominal part and a pelvic part.

1. pelvis of ureter.
2. abdominal part of ureter.
3. pelvic part of ureter.
4. intramural part of ureter (embedded in the wall of the urinary bladder).

* The junction between the pelvis of the ureter and the ureter proper lies opposite the lower end of the kidney.

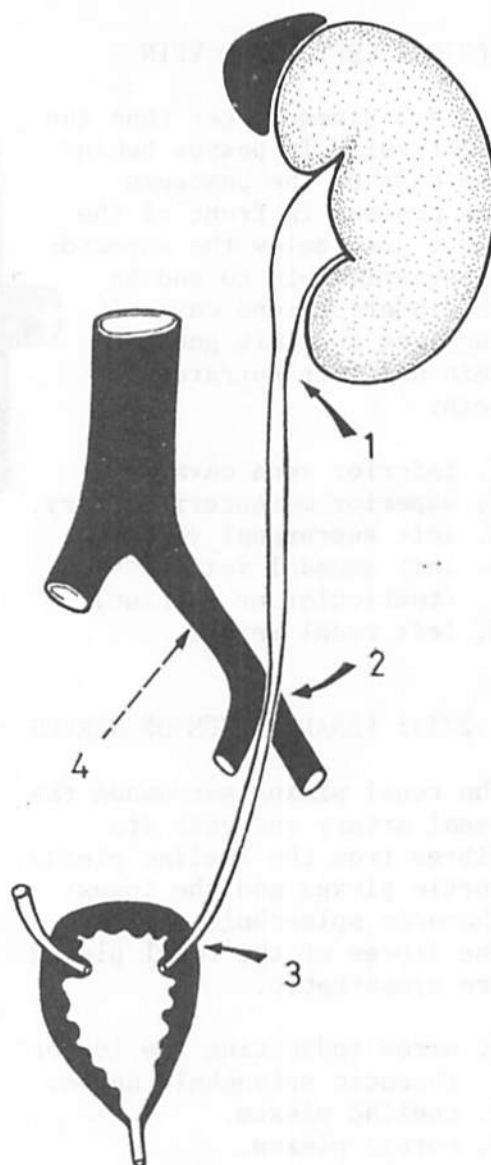


Fig.(274): CONSTRICTIONS OF THE URETER

The ureter is constricted at the pelvi-ureteric junction, where it crosses the common iliac artery and as it passes through the bladder wall.

1. pelvi-ureteric junction.
2. ureter crossing the common iliac artery.
3. intramural part of ureter.
4. left common iliac artery.

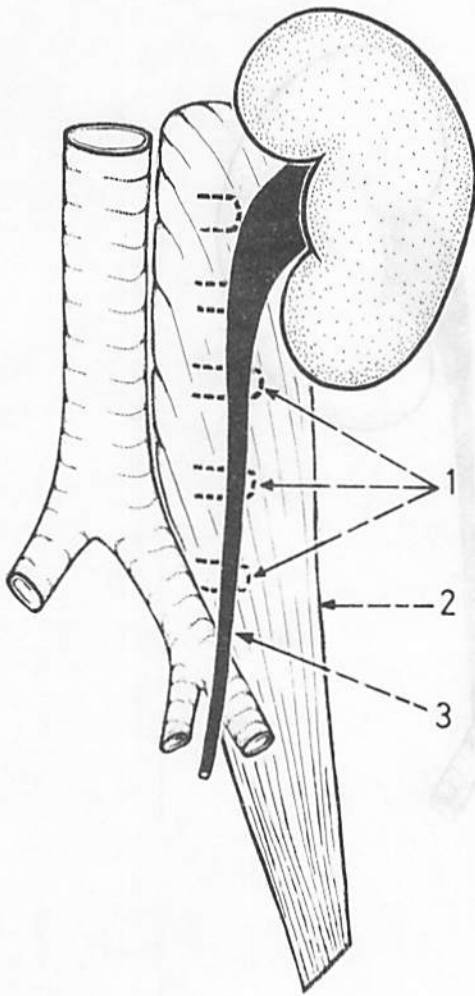


Fig.(275): RELATION OF THE URETER TO PSOAS MAJOR

The abdominal part of the ureter descends vertically behind the peritoneum on the front of the psoas major. This muscle intervenes between the ureter and the tips of the transverse processes of the lumbar vertebrae.

1. tips of transverse processes of lumbar vertebrae.
2. psoas major muscle.
3. ureter.

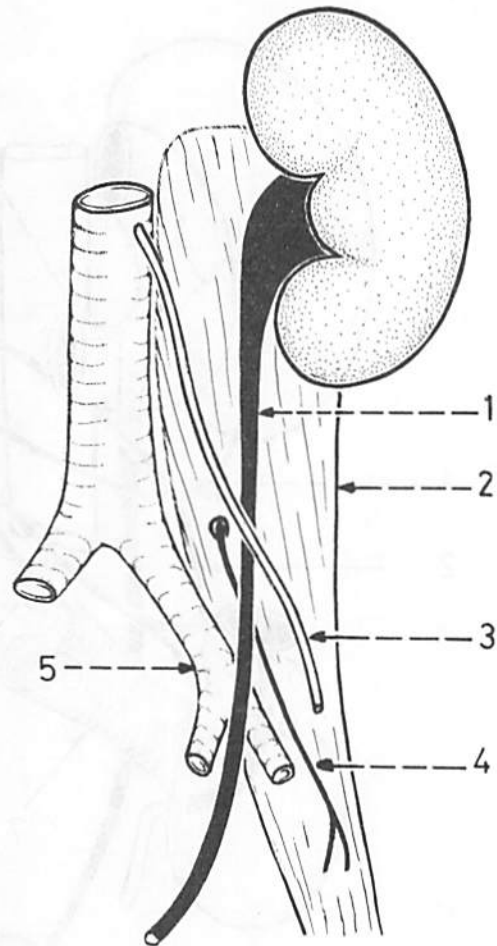


Fig.(276): RELATIONS OF THE URETER COMMON TO BOTH SIDES

These are its relation to the psoas major, gonadal vessels, genitofemoral nerve and end of the common iliac artery.

1. ureter in front of psoas major.
2. psoas major.
3. gonadal vessel crossing in front of the ureter.
4. genitofemoral nerve crossing behind the ureter.
5. end of common iliac artery crossed by the ureter.

* Note that most of the relations of the abdominal part of the ureter are different on both sides.

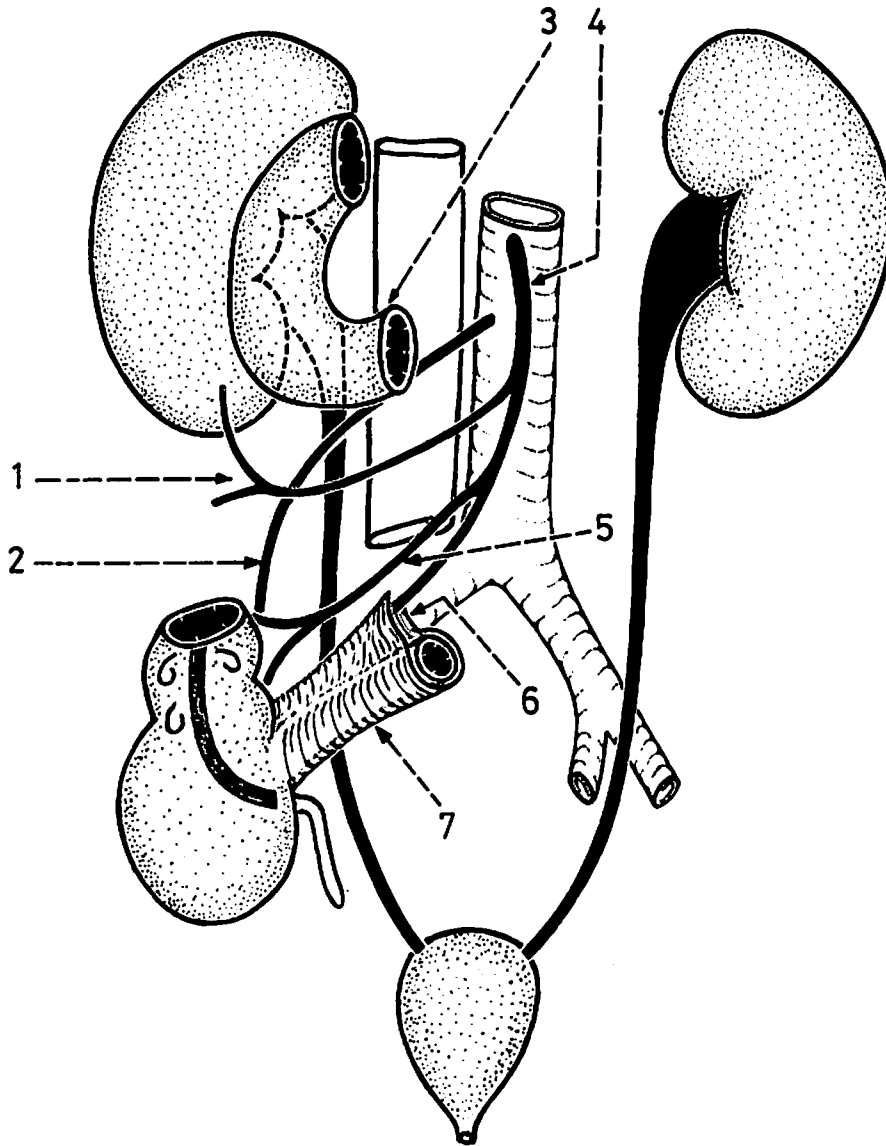


Fig.(277): RELATIONS OF THE URETER ON THE RIGHT SIDE

The right ureter lies under cover of the descending part of the duodenum and the beginning of its horizontal part, to the right of the inferior vena cava, and is crossed by the following structures: gonadal vessels, right colic vessels, ileocolic vessels and lower part of the mesentery together with the terminal part of the ileum.

1. right colic artery.
2. gonadal artery (testicular or ovarian).
3. horizontal part of duodenum.
4. superior mesenteric artery.
5. ileocolic artery.
6. mesentery of small intestine.
7. terminal part of ileum.

* Remember the other relations which are common to both sides, see figure 276.

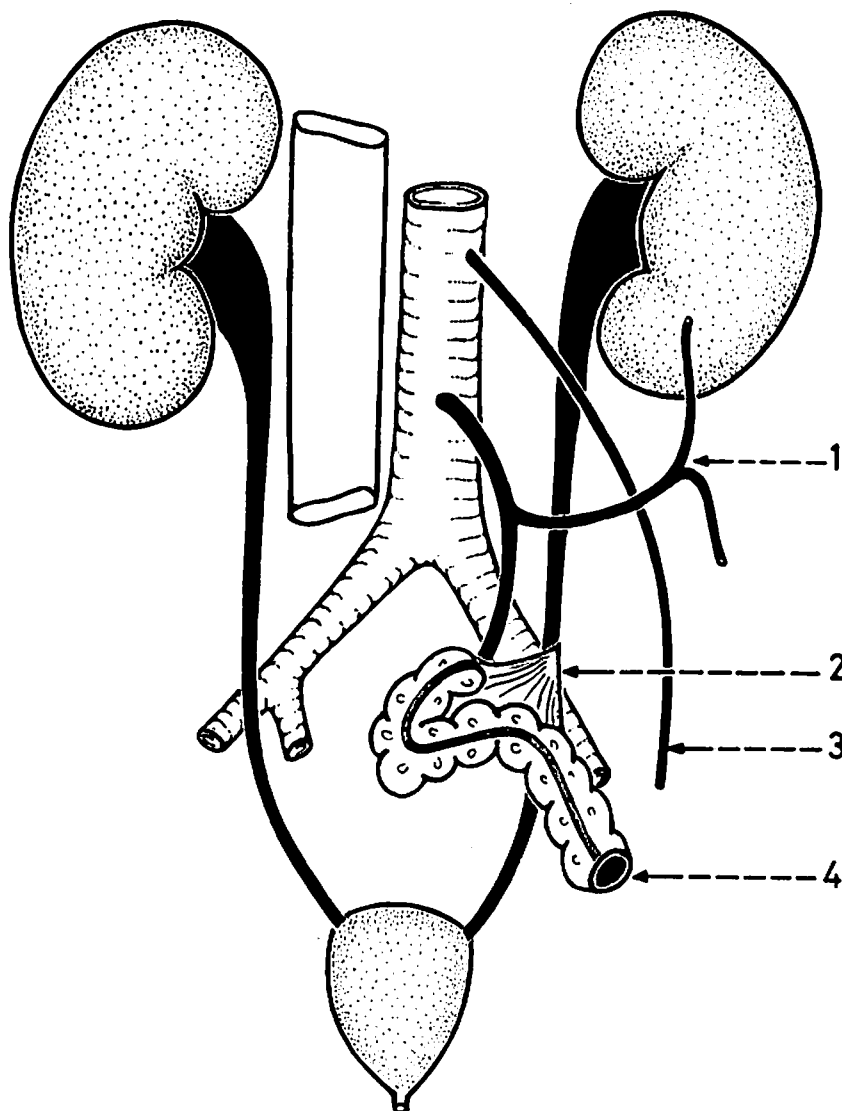


Fig.(278): RELATIONS OF THE URETER ON THE LEFT SIDE

The left ureter is crossed by: gonadal vessels, left colic vessels, and near the inlet of the pelvis by the sigmoid colon and sigmoid mesocolon.

1. left colic artery.
2. sigmoid mesocolon.
3. gonadal artery (testicular or ovarian).
4. sigmoid colon.

* Remember the other relations which are common to both sides, see figure 276.

* Note that the left ureter has fewer anterior relations than the right ureter and this facilitates its surgical exposure.

Fig.(279): ARTERIAL SUPPLY OF THE URETER

The arteries supplying the ureter are derived from: renal, abdominal aorta, testicular or ovarian, common iliac, internal iliac, superior and inferior vesical and uterine arteries. These branches anastomose together to form a longitudinal chain on the wall of the ureter.

1. renal artery.
2. abdominal aorta.
3. common iliac artery.
4. internal iliac artery.
5. inferior vesical artery.
6. testicular or ovarian artery.
7. superior vesical artery.

* The inferior vesical artery is a constant source of blood supply to the lower part of the ureter and its branches to the ureter should be kept intact in case of surgical implantation of the lower end of the ureter into the colon, otherwise ischaemic necrosis of the lower part of the ureter occurs.

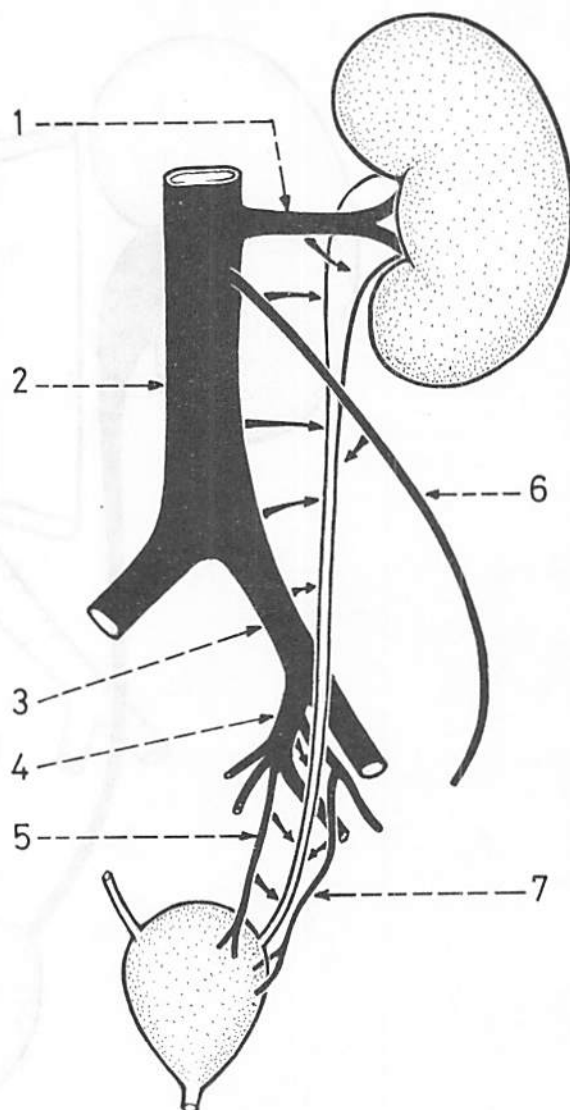


Fig.(280): SURFACE ANATOMY OF THE URETER

The ureter can be projected to the surface by drawing a vertical line from a point in the transpyloric plane 5 cm from the median plane (point 1), down to the pubic tubercle (point 2); this line roughly corresponds to the linea semilunaris.

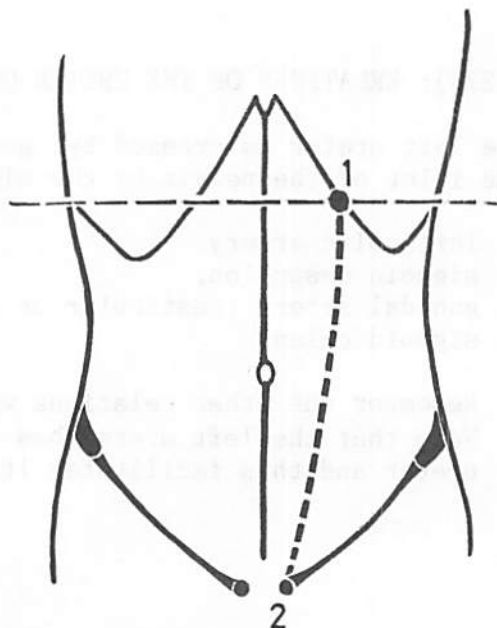


Fig.(281): RADIOGRAPHIC APPEARANCE OF THE URETER

The course of the ureter can be demonstrated radiographically either by plain X-ray or by using radio-opaque substance (pyelography). The ureter should be examined carefully for stone impaction at the following 3 sites:

- * near the tip of transverse process of 2nd L.V. (pelvi-ureteric junction).
- * opposite the sacro-iliac joint (where it crosses the common iliac artery).
- * a short distance medial to the ischial spine (lower end of the ureter).

1. 1st lumbar vertebra.
2. sacro-iliac joint.
3. ischial spine.
4. urinary bladder.

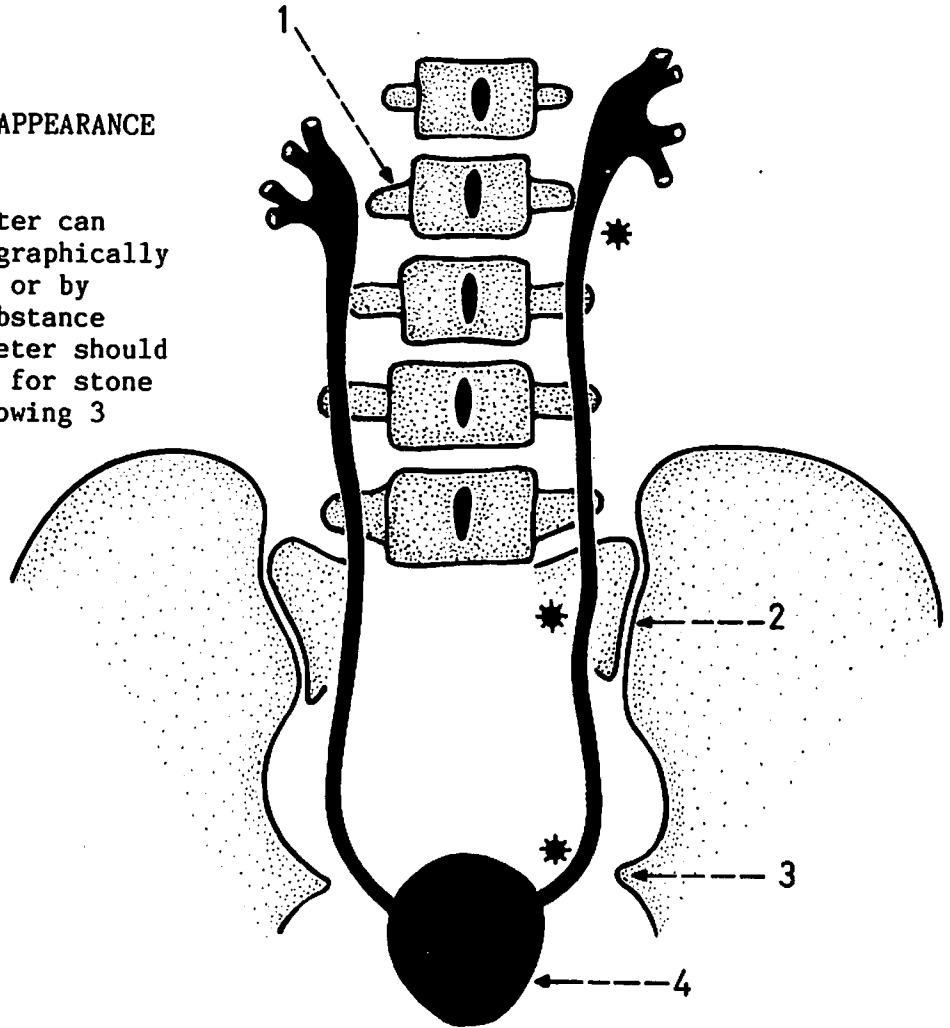
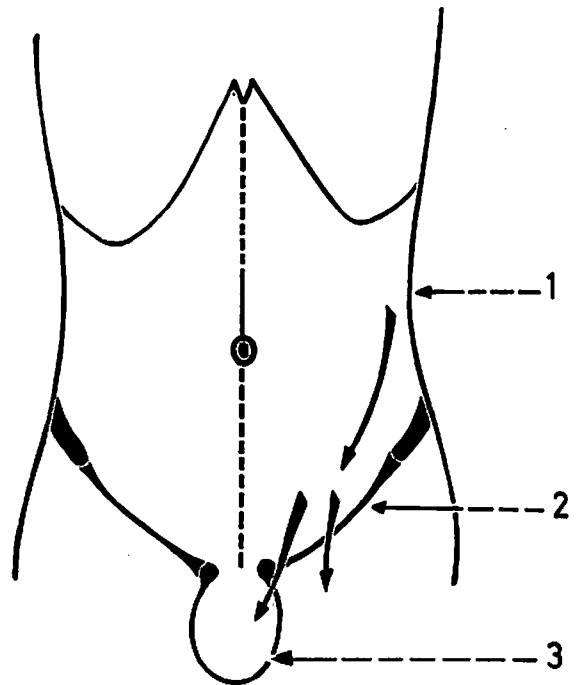


Fig.(282): REFERRED PAIN FROM THE URETER

In renal colic (due to impacted stone in the ureter, for example) pain is referred to the skin areas of the anterior abdominal wall supplied by the lower 3 thoracic and 1st lumbar nerves. Pain starts in the loin and shoots downwards to the groin and scrotum. Pain may radiate along the genito-femoral nerve to the cremaster muscle which may contract and retract the testis.

1. loin.
2. groin.
3. scrotum.



SUPRARENAL GLANDS

Fig.(283): SUPRARENAL GLANDS

They lie one on each side of the median plane immediately above the upper end of the kidney.

- (a) In the adult: the right suprarenal is pyramidal in shape while the left one is semilunar. The adult gland is about $\frac{1}{30}$ of the size of the kidney.
 - (b) At birth: the suprarenal gland is larger than the adult one; it is about $\frac{1}{3}$ of the size of the kidney.
1. right suprarenal vein(directed upwards and to the left).
 2. left suprarenal vein(directed downwards).

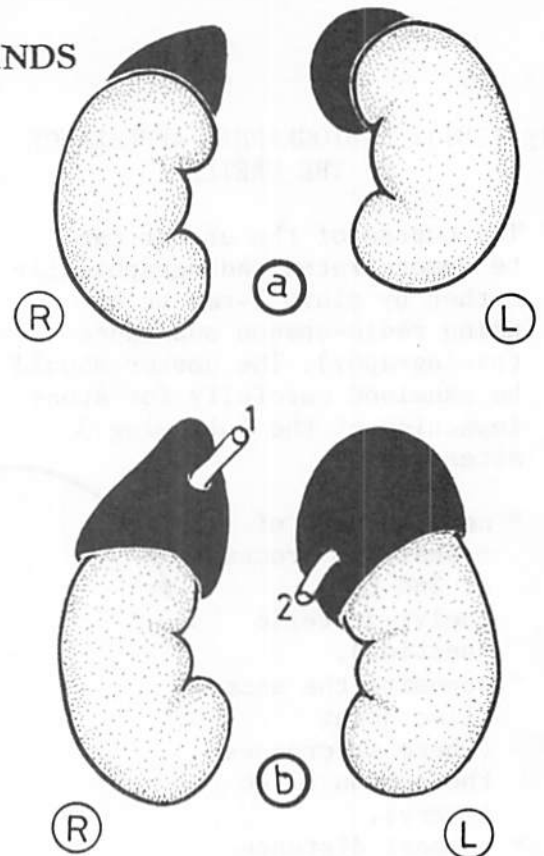


Fig.(284): ANTERIOR RELATIONS OF THE SUPRARENAL GLANDS

The anterior surface of the right gland is related medially to the inferior vena cava and laterally to the back of the right lobe of the liver. The anterior surface of the left gland is related to the lesser sac in its upper part and to the body of the pancreas in its lower part.

1. lateral part of right suprarenal gland (lies behind the right lobe of the liver at the base of the bare area).
2. medial part of right suprarenal gland (under cover of the inferior vena cava).
3. upper part of left suprarenal gland (covered by the lesser sac and the back of the stomach).
4. lower part of left suprarenal gland (covered by the body of pancreas).

* The 2 suprarenal glands are close to the median plane, and the distance between this plane and each gland is about 2 cm.

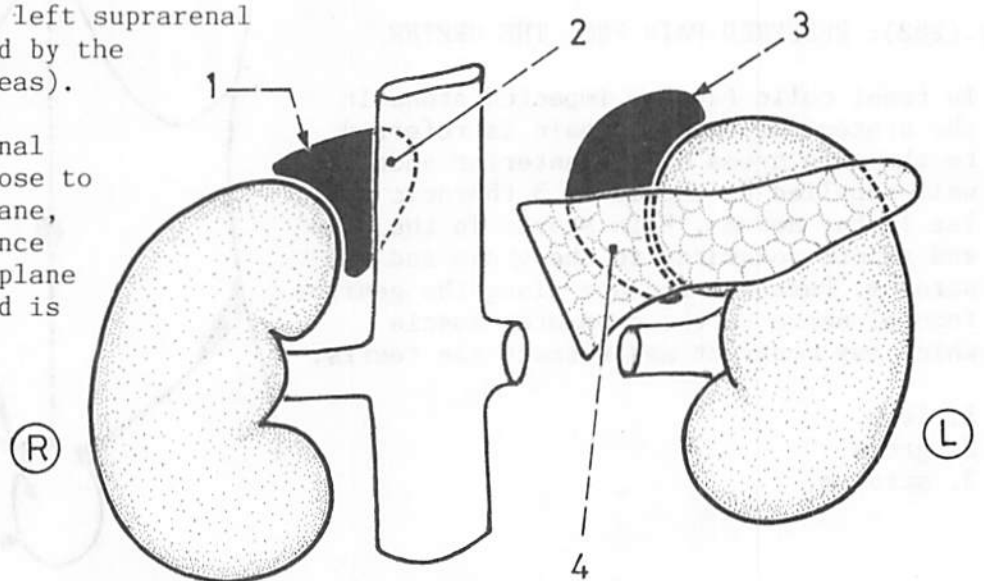


Fig.(285): POSTERIOR AND MEDIAL RELATIONS OF SUPRARENAL GLANDS

The posterior surface of each gland is related to the upper end of the kidney and to the related crus of diaphragm. Medially, each gland is closely related to a coeliac ganglion.

1. right suprarenal gland.
2. right crus of diaphragm.
3. right coeliac ganglion.
4. left coeliac ganglion.
5. left crus of diaphragm.
6. left suprarenal gland.

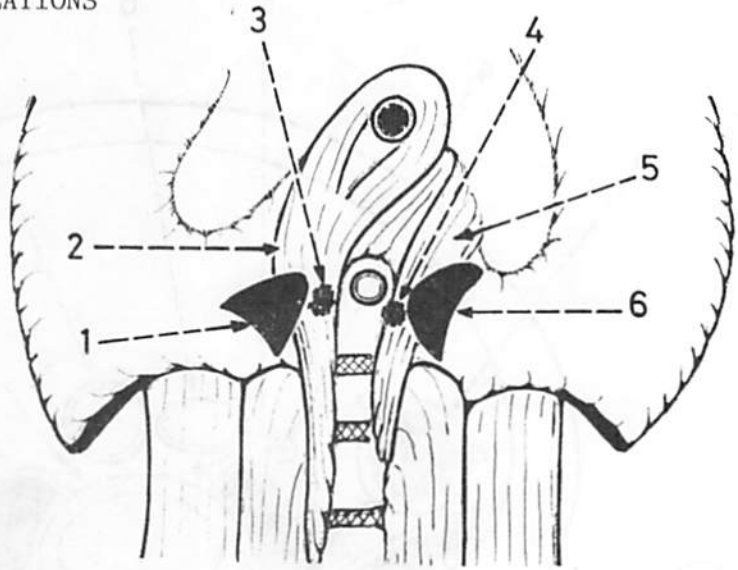
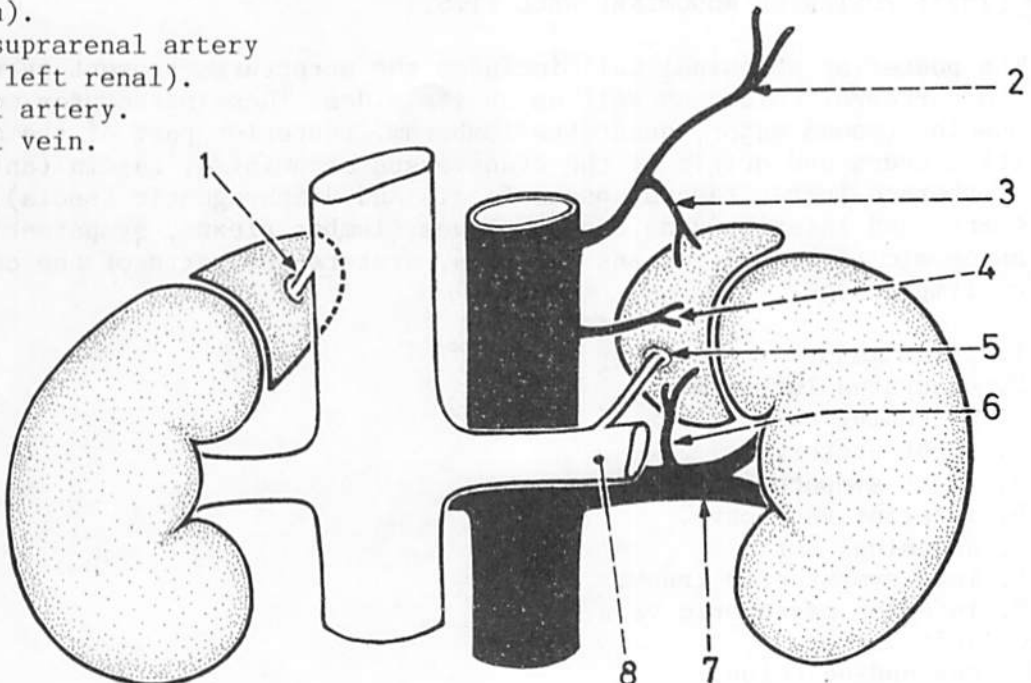


Fig.(286): VESSELS OF THE SUPRARENAL GLAND

The suprarenal gland, whether right or left, is supplied by 3 arteries (superior, middle and inferior) but is supplied by one vein. The right suprarenal vein ends in the inferior vena cava while the left vein ends in the left renal vein.

1. right suprarenal vein (directed upwards and forwards to end in the inferior vena cava).
2. left inferior phrenic artery.
3. superior suprarenal artery (from the inferior phrenic).
4. middle suprarenal artery (directly from the aorta).
5. left suprarenal vein (directed downwards and forwards to end in the left renal vein).
6. inferior suprarenal artery (from the left renal).
7. left renal artery.
8. left renal vein.



POSTERIOR ABDOMINAL WALL

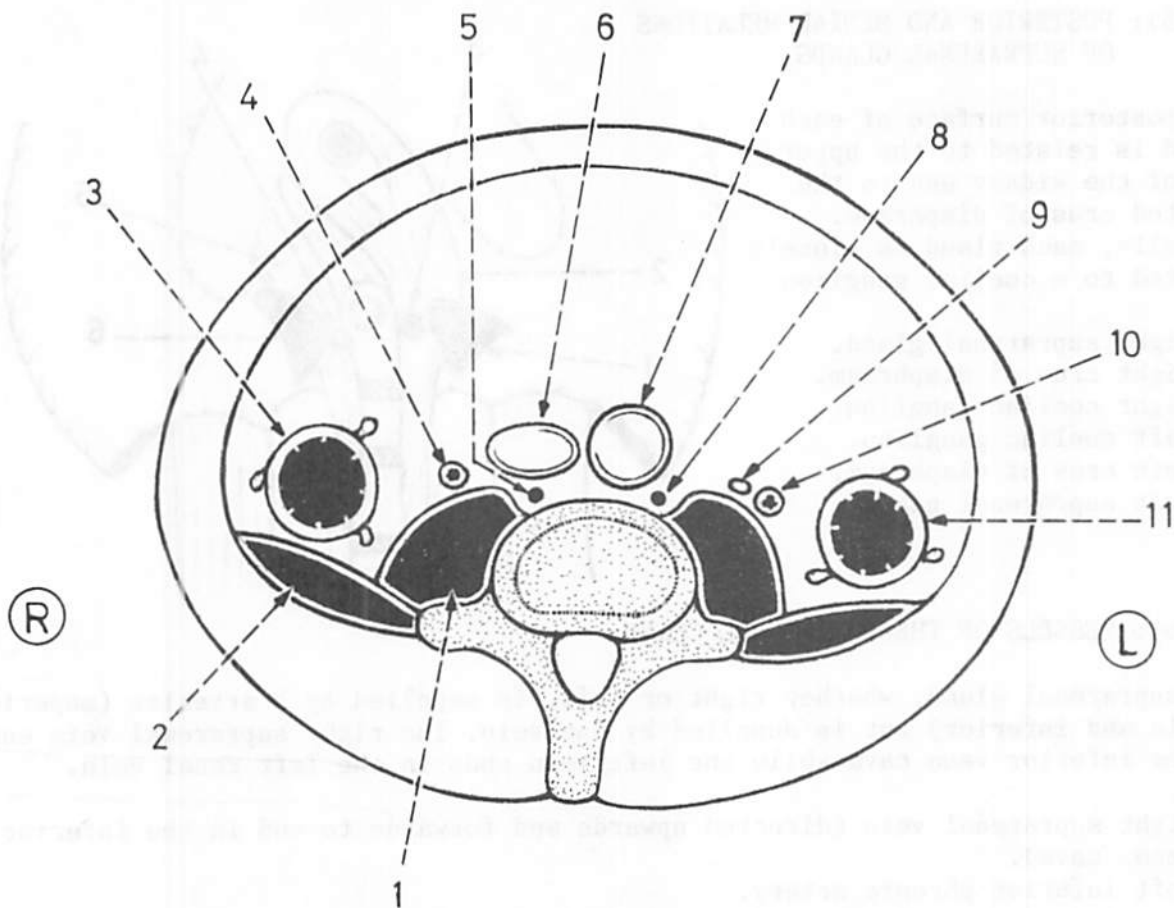


Fig.(287): POSTERIOR ABDOMINAL WALL (T.S.)

The posterior abdominal wall includes the structures present on the front of the vertebral column as well as on its sides. These structures consist of muscles (psoas major, quadratus lumborum, posterior part of the diaphragm and its 2 crura and origin of the transversus abdominis), fascia (anterior layer of thoraco-lumbar fascia, psoas fascia and diaphragmatic fascia), vessels (aorta and inferior vena cava), nerves (lumbar plexus, sympathetic trunks and autonomic plexuses), organs (kidneys, ureters and parts of the colon) and groups of lymph nodes.

1. psoas major.
2. quadratus lumborum.
3. ascending colon.
4. right ureter.
5. right sympathetic trunk.
6. inferior vena cava.
7. abdominal aorta.
8. left sympathetic trunk.
9. inferior mesenteric vein.
10. left ureter.
11. descending colon.

Fig.(288): MUSCLES OF THE POSTERIOR ABDOMINAL WALL

These are: psoas major, quadratus lumborum and iliacus; a psoas minor may be present in front of the psoas major.

1. diaphragm.
2. origin of transversus abdominis (just lateral to the quadratus lumborum).
3. quadratus lumborum (extends between the iliac crest and the last rib, just lateral to the psoas major).
4. iliacus (fills the iliac fossa).
5. psoas major (lies along the side of the lumbar vertebrae and along the side of the pelvic inlet).
6. 5th lumbar vertebra.

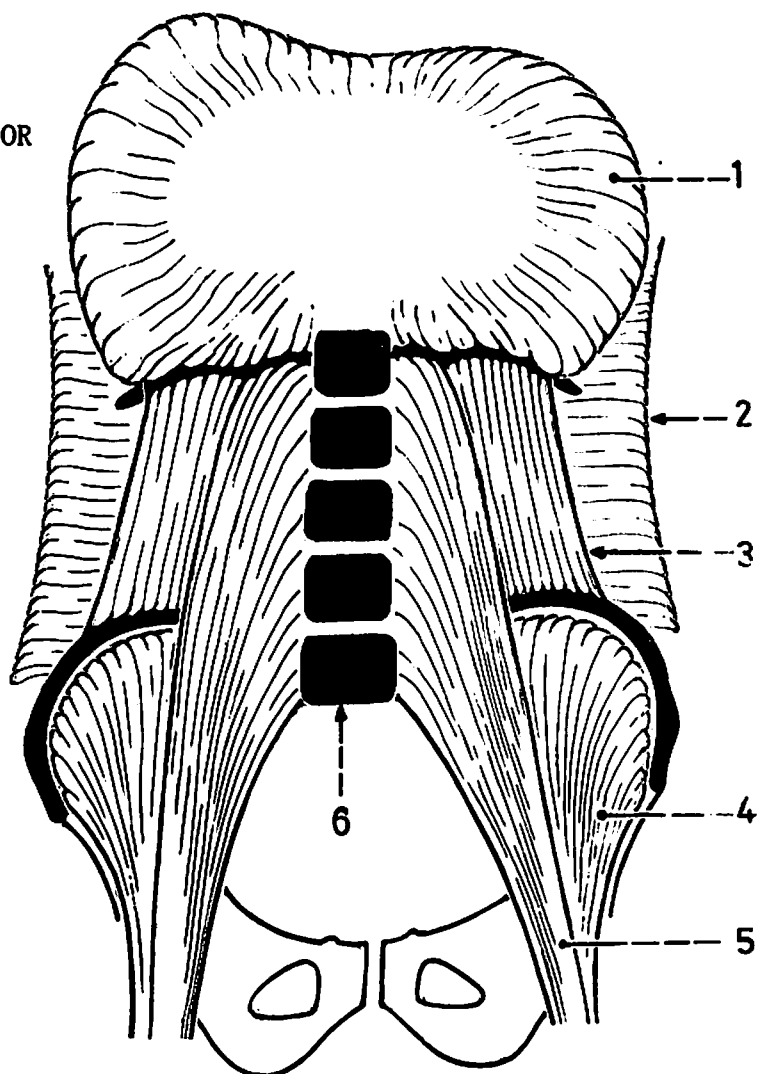
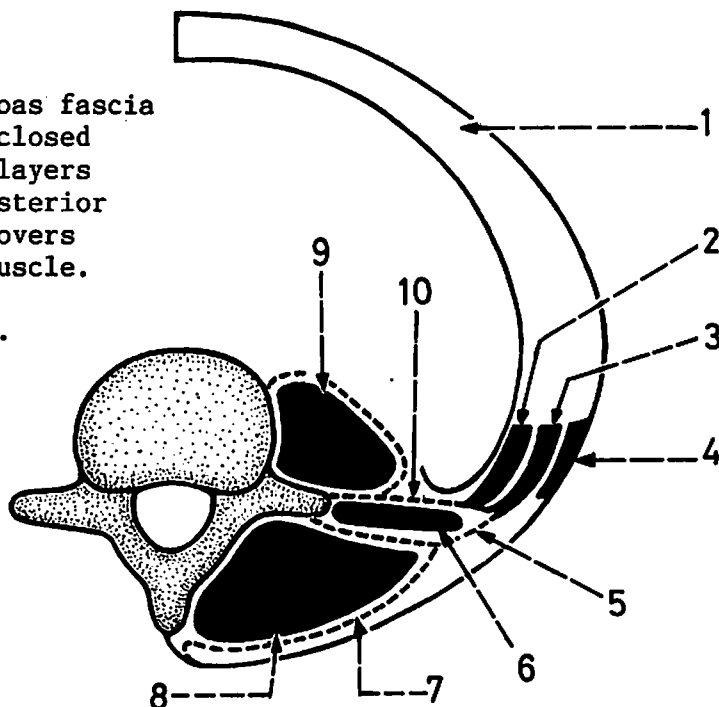


Fig.(289): MUSCLES OF POSTERIOR ABDOMINAL WALL AND RELATED FASCIAE (T.S.)

The psoas major is covered by psoas fascia and the quadratus lumborum is enclosed between the anterior and middle layers of thoraco-lumbar fascia. The posterior layer of thoraco-lumbar fascia covers the back of the erector spinae muscle.

1. antero-lateral abdominal wall.
2. transversus abdominis.
3. internal oblique.
4. external oblique.
5. middle layer of thoraco-lumbar fascia.
6. quadratus lumborum.
7. posterior layer of thoraco-lumbar fascia.
8. erector spinae muscle.
9. psoas major and its fascia.
10. anterior layer of thoraco-lumbar fascia.



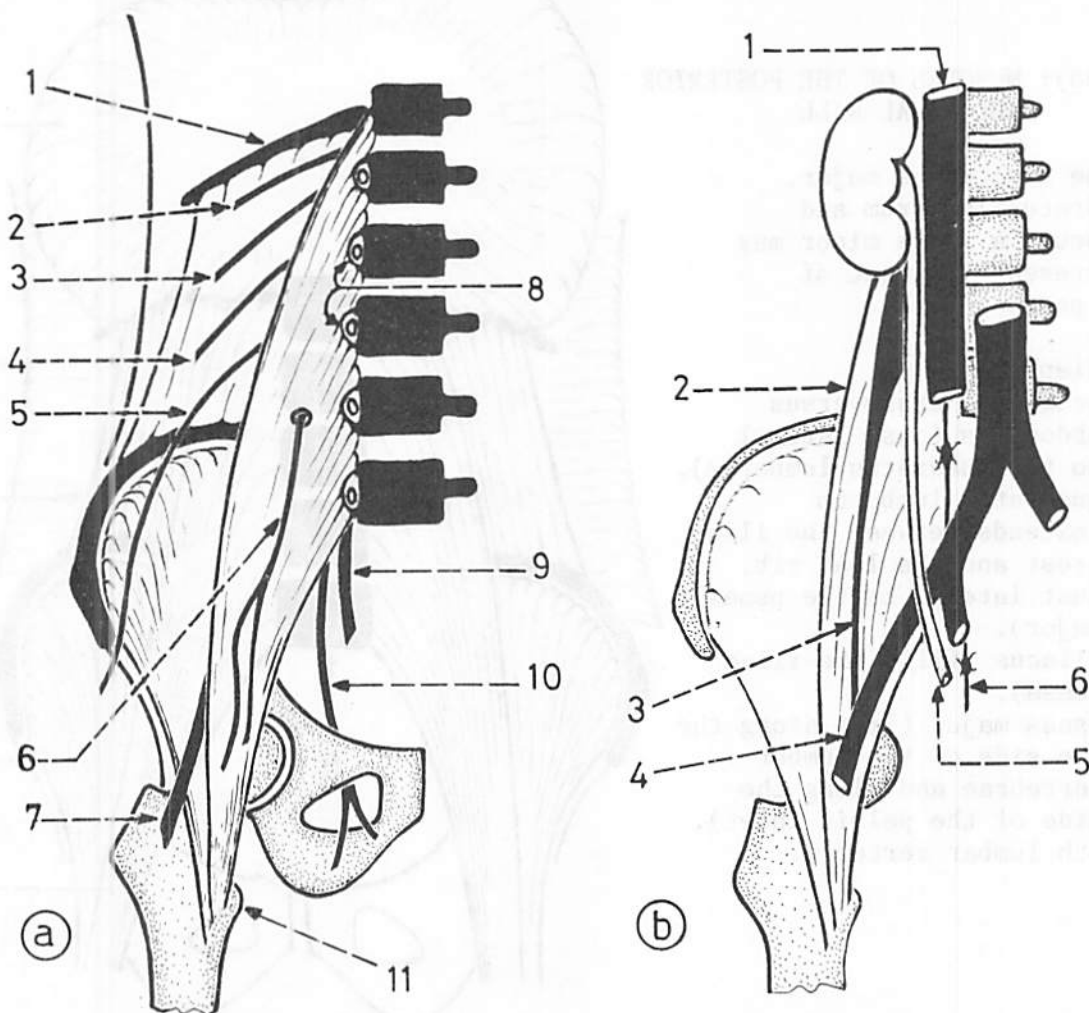


Fig.(290): RELATIONS OF PSOAS MAJOR

(a) Lateral, anterior and medial relations:

1. last rib.
2. subcostal nerve (lateral).
3. iliohypogastric nerve (lateral).
4. ilio-inguinal nerve (lateral).
5. lateral cutaneous nerve of thigh (lateral).
6. genitofemoral nerve (anterior).
7. femoral nerve (lateral and lowermost).
8. origin of psoas major arching over lumbar arteries.
9. lumbar trunk (medial).
10. obturator nerve (medial).
11. lesser trochanter receiving the insertion of iliopsoas muscle.

(b) Further anterior and medial relations:

1. inferior vena cava (along the medial margin).
2. psoas major.
3. psoas minor (anterior).
4. external iliac artery (along the medial margin).
5. ureter (anterior).
6. sympathetic trunk (along the medial margin).

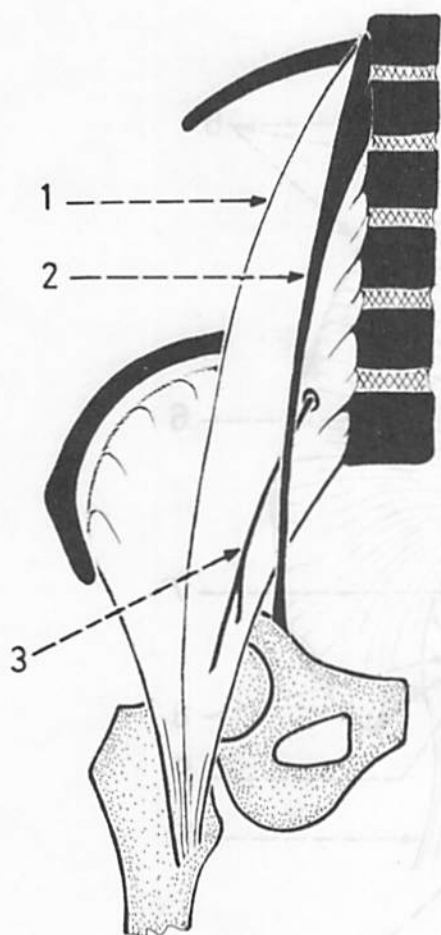


Fig.(291): PSOAS MINOR MUSCLE

It is a long slender muscle which lies in front of the psoas major; it may be absent.

1. psoas major.
2. psoas minor (inserted into the iliopectineal eminence).
3. genitofemoral nerve.

* Note that the psoas major arises from all 5 lumbar vertebrae and the related intervertebral discs, and is inserted into the lesser trochanter of the femur.

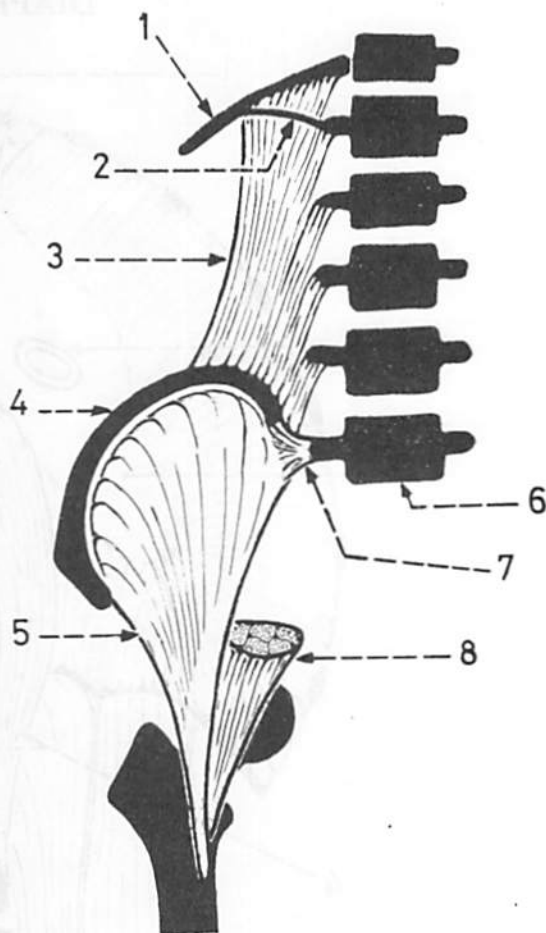


Fig.(292): QUADRATUS LUMBORUM MUSCLE

It is quadrilateral in shape; it arises from the iliolumbar ligament and the iliac crest and is inserted into the last rib and the tips of the transverse processes of the upper 4 lumbar vertebrae.

1. last rib.
2. lateral arcuate ligament (arching over the quadratus lumborum).
3. quadratus lumborum.
4. iliac crest.
5. iliacus (arises from the iliac fossa and is inserted into the lesser trochanter).
6. 5th lumbar vertebra.
7. iliolumbar ligament.
8. psoas major muscle (cut).

* The quadratus lumborum forms the muscle bed for the kidney and the ascending or descending colon.

DIAPHRAGM

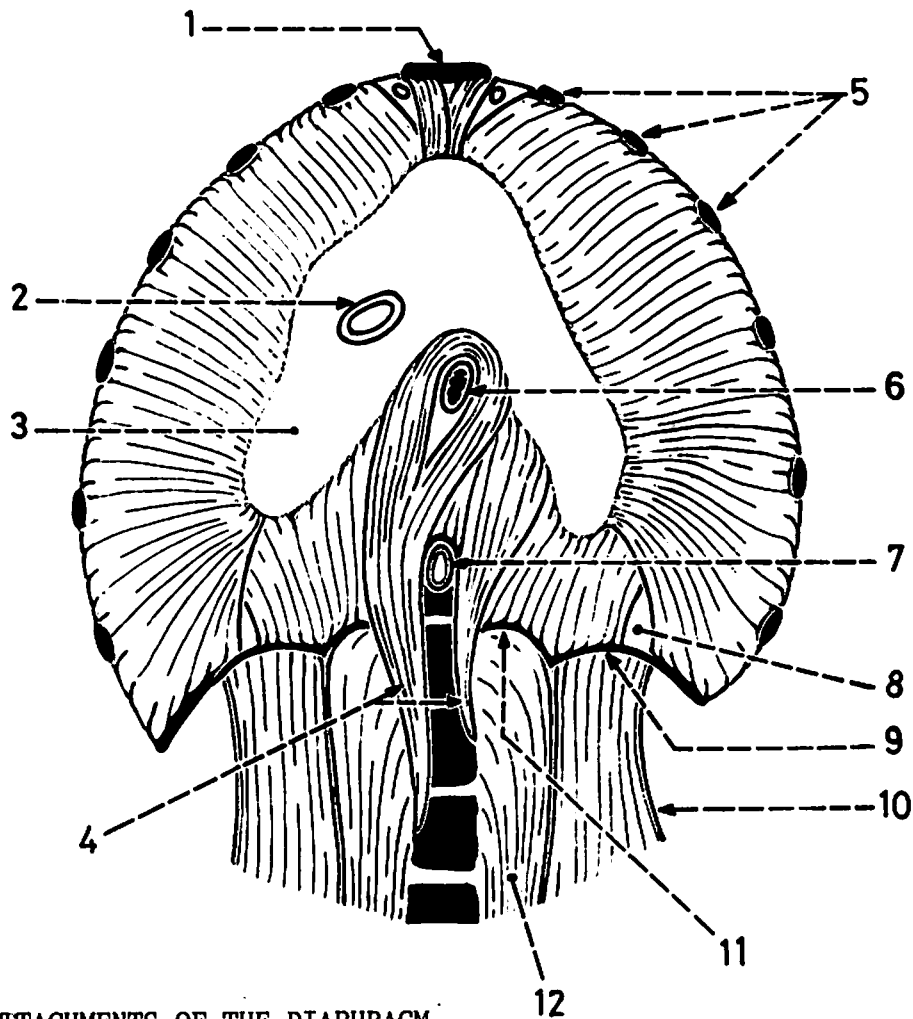


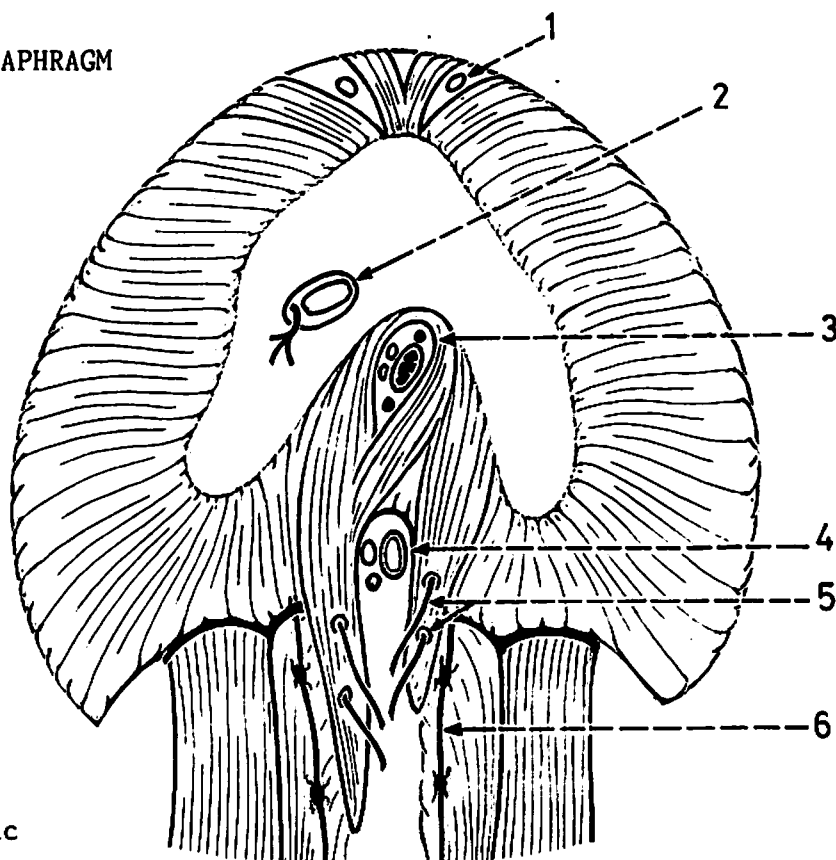
Fig.(293): ATTACHMENTS OF THE DIAPHRAGM

The diaphragm is dome-shaped with a peripheral muscular part (origin) and a central tendinous part (insertion). It arises from the circumference of the thoracic outlet by fleshy digitations which are grouped into 3 parts: sternal part (from the back of xiphoid process), costal part (from the inner surfaces of the lower 6 costal cartilages) and lumbar part (from the lumbar vertebrae by 2 crura and 5 arcuate ligaments). It is inserted into the central tendon.

1. xiphoid process (sternal origin).
2. opening for inferior vena cava (in the central tendon).
3. central tendon of diaphragm (situated near the centre of the dome).
4. right and left crura (arise from the sides of lumbar vertebrae).
5. costal cartilages (costal origin).
6. oesophageal opening (in the fleshy part of right crus).
7. aortic opening (behind the median arcuate ligament).
8. lumbo-costal triangle (a deficiency above the last rib).
9. lateral arcuate ligament (arches over the quadratus lumborum).
10. quadratus lumborum.
11. medial arcuate ligament (arches over the psoas major).
12. psoas major.

Fig.(294): OPENINGS OF THE DIAPHRAGM

There are 3 large openings in addition to some small ones. The large openings are: aortic (for aorta, thoracic duct and azygos vein), oesophageal (for oesophagus, 2 vagi and oesophageal branches of left gastric artery) and opening for inferior vena cava (transmits I.V.C. and the right phrenic nerve).

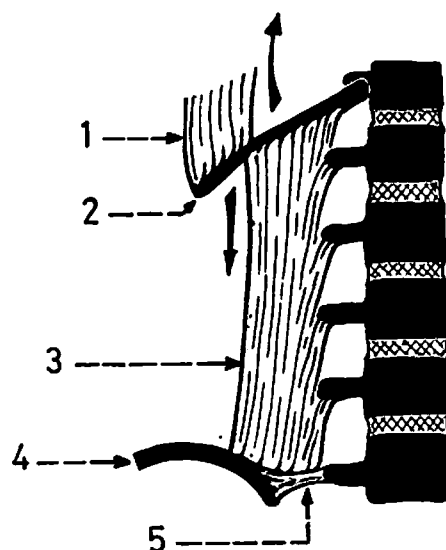


1. gap for superior epigastric artery (between the sternal and costal origins).
2. Opening for inferior vena cava (transmits I.V.C. and right phrenic nerve).
3. oesophageal opening (transmits oesophagus, 2 vagi and oesophageal arteries).
4. aortic opening (transmits aorta, thoracic duct and azygos vein).
5. openings for greater and lesser splanchnic nerves (in the crus).
6. sympathetic trunk (behind the medial arcuate ligament).

Fig.(295): FIXATION OF THE LAST RIB

The last rib should be fixed in position during contraction of the fleshy fibres of the diaphragm to allow for descent of the central tendon. As the last rib is floating, its fixation is carried out by the quadratus lumborum muscle.

1. costal origin of diaphragm from last rib (pulls the rib upwards).
2. last rib.
3. quadratus lumborum (pulls the rib downwards to counteract the action of the diaphragm).
4. iliac crest.
5. iliolumbar ligament.



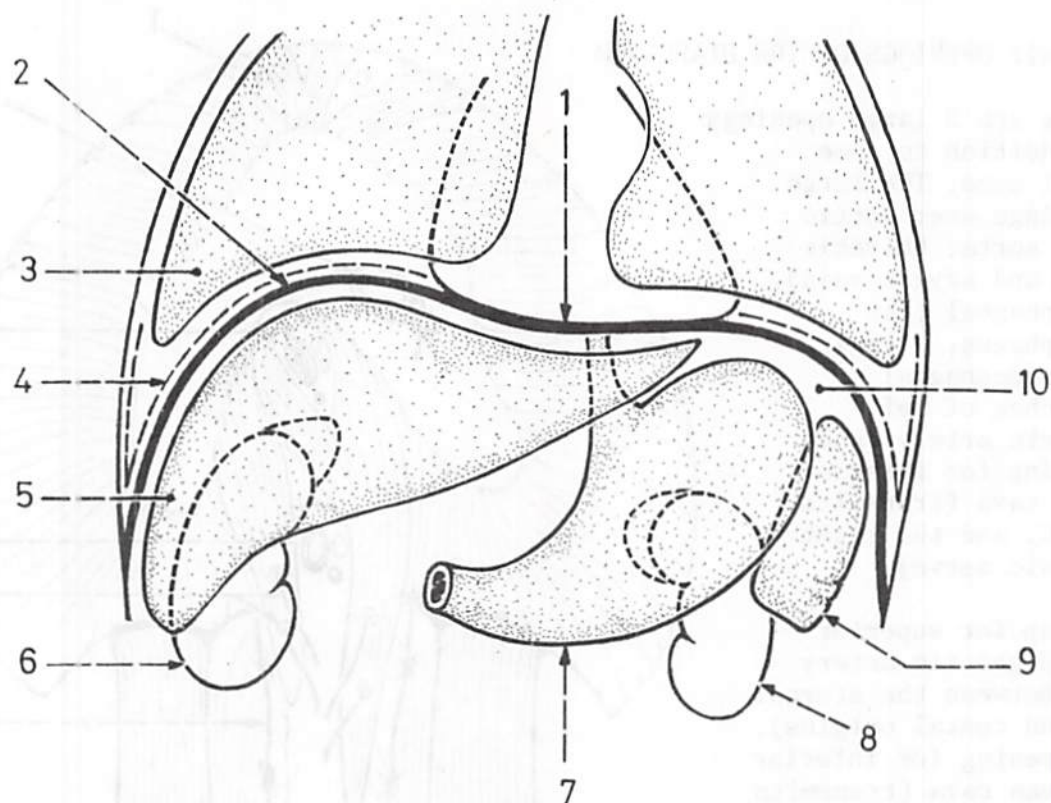


Fig.(296): RELATIONS OF THE DIAPHRAGM

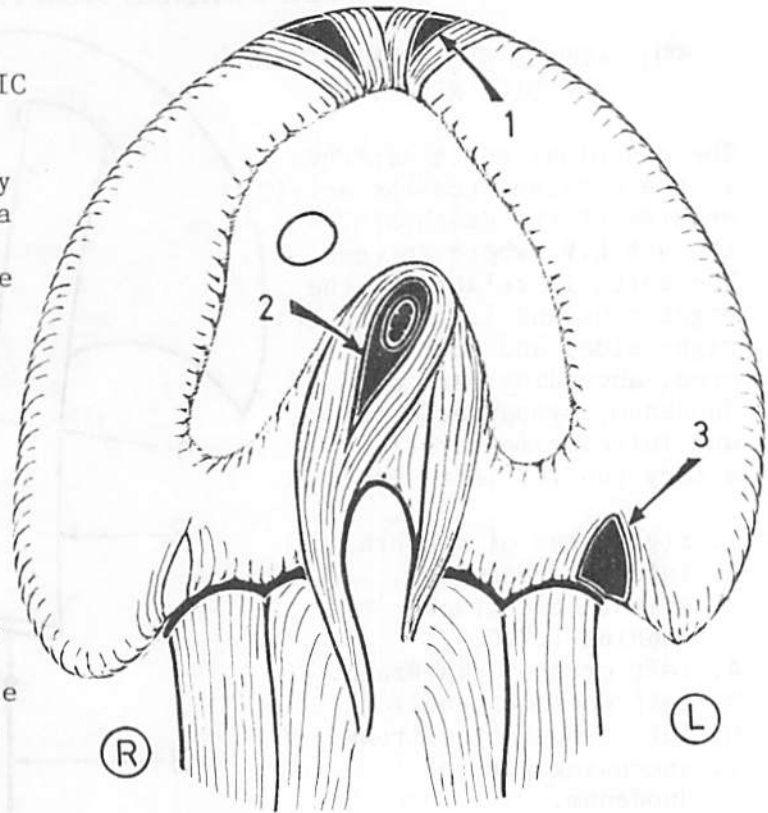
The upper surface of the diaphragm is related to the pericardium and heart at its middle part, and to the pleura and base of the lung on each side. The lower surface of the diaphragm is related to right lobe of liver, right kidney and right suprarenal gland (on the right side), and to left lobe of liver, fundus of stomach, spleen, left kidney and left suprarenal gland (on the left side).

1. base of the pericardium (fused with the central tendon of the diaphragm).
2. right cupola of the diaphragm.
3. base of right lung.
4. pleura on the upper surface of the diaphragm.
5. right lobe of liver (separated from the diaphragm by the right subphrenic space).
6. right kidney.
7. stomach.
8. left kidney.
9. spleen.
10. left subphrenic space.

* The higher position of the right cupola of the diaphragm than that of the left cupola is due to the presence of most of the liver on the right side.

Fig.(297): SITES FOR DIAPHRAGMATIC HERNIAS

A diaphragmatic hernia usually results from the presence of a congenital defect in the diaphragm. Herniation may take place through an abnormally wide oesophageal opening (hiatus hernia), through the lumbo-costal triangle or rarely through a wide gap behind the xiphoid process.



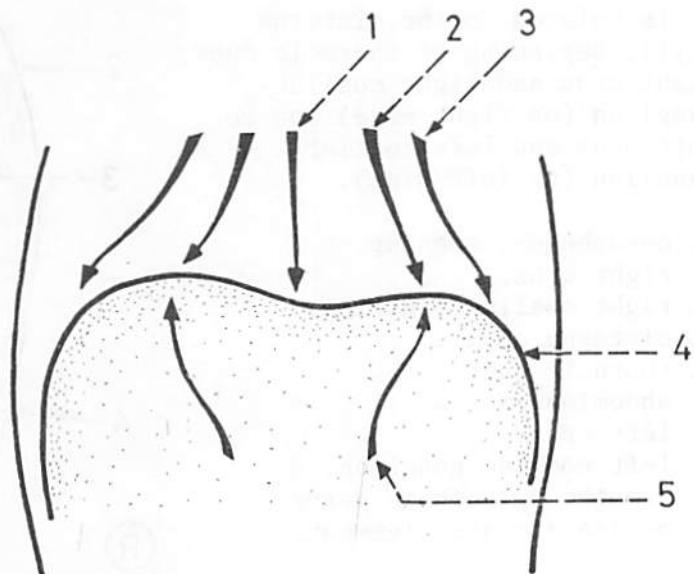
1. foramen of Morgagni:
a wide gap between the sternal and costal origins of the diaphragm and may allow the colon to herniate through it into the chest.
2. wide oesophageal opening:
allows herniation of the stomach leading to hiatus hernia.
3. foramen of Bochdalek:
corresponds to the lumbo-costal triangle and is more common on the left side.

* The lumbo-costal triangle is a triangular deficiency in the fleshy fibres between the origin from the last rib and that from the lateral arcuate ligament.

Fig.(298): ARTERIES OF THE DIAPHRAGM

These are superior phrenic, musculophrenic and pericardiophrenic (from above) and inferior phrenic (from below).

1. superior phrenic (from thoracic aorta).
2. musculophrenic (from internal thoracic).
3. pericardiophrenic (from internal thoracic).
4. diaphragm.
5. inferior phrenic (from abdominal aorta).



ABDOMINAL AORTA

Fig.(299): COURSE OF ABDOMINAL AORTA AND SIDE RELATIONS

The abdominal aorta descends in the midline from the aortic opening of the diaphragm to the 4th L.V. where it ends. The aorta is related to the right crus and I.V.C. (on its right side) and to the left crus, ascending part of duodenum, sympathetic trunk and inferior mesenteric artery (on its left side).

1. right crus of diaphragm.
2. inferior vena cava.
3. sympathetic trunk (behind I.V.C.).
4. left crus of diaphragm.
5. left coeliac ganglion.
6. left sympathetic trunk.
7. ascending part of duodenum.
8. inferior mesenteric artery (partly in front of the aorta and partly on its left side).

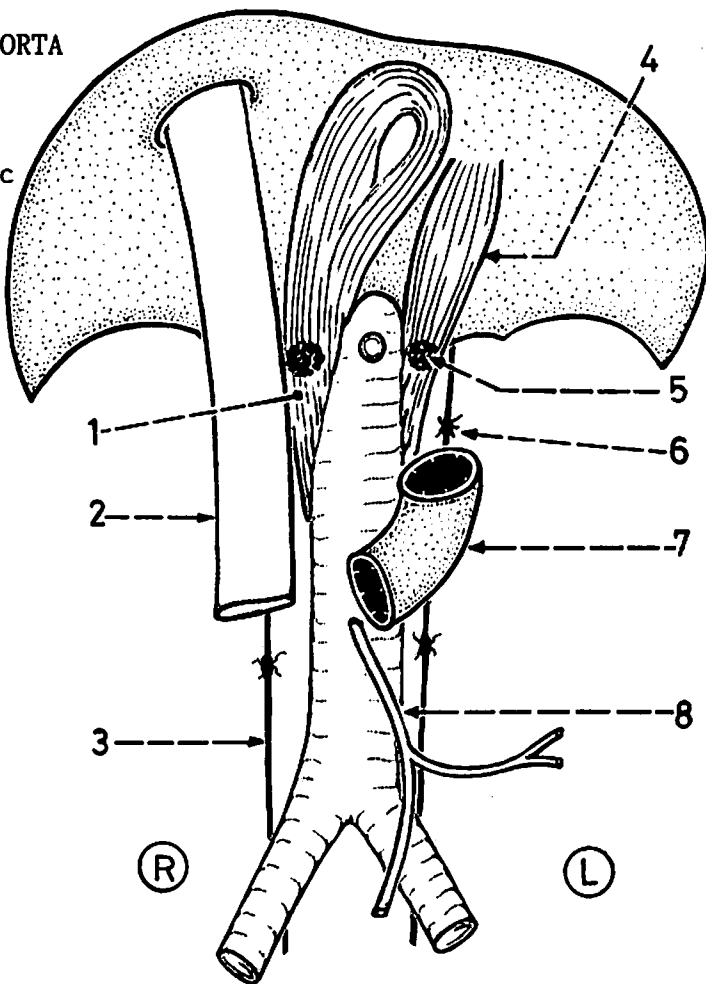
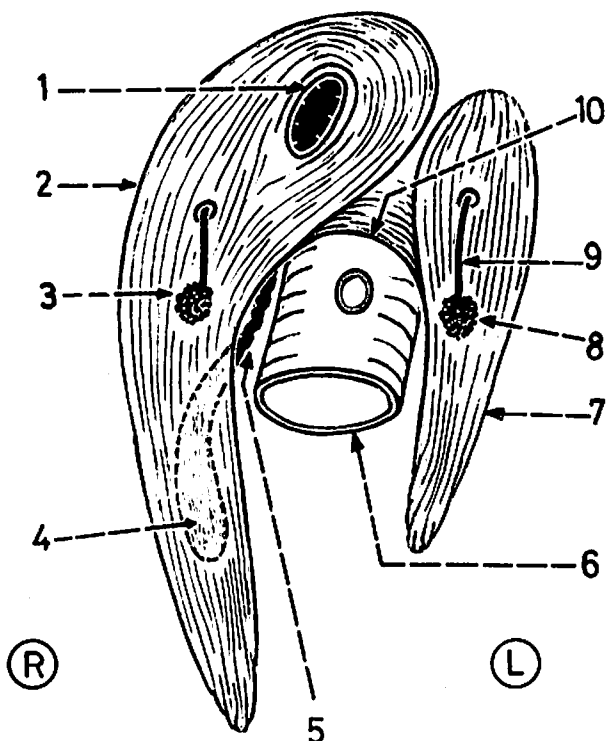


Fig.(300): SIDE RELATIONS OF ABDOMINAL AORTA AT ITS BEGINNING

It is related to the cisterna chyli, beginning of thoracic duct, right crus and right coeliac ganglion (on right side) and to left crus and left coeliac ganglion (on left side).

1. oesophageal opening.
2. right crus.
3. right coeliac ganglion.
4. cisterna chyli.
5. thoracic duct.
6. abdominal aorta.
7. left crus.
8. left coeliac ganglion.
9. greater splanchnic nerve.
10. median arcuate ligament.



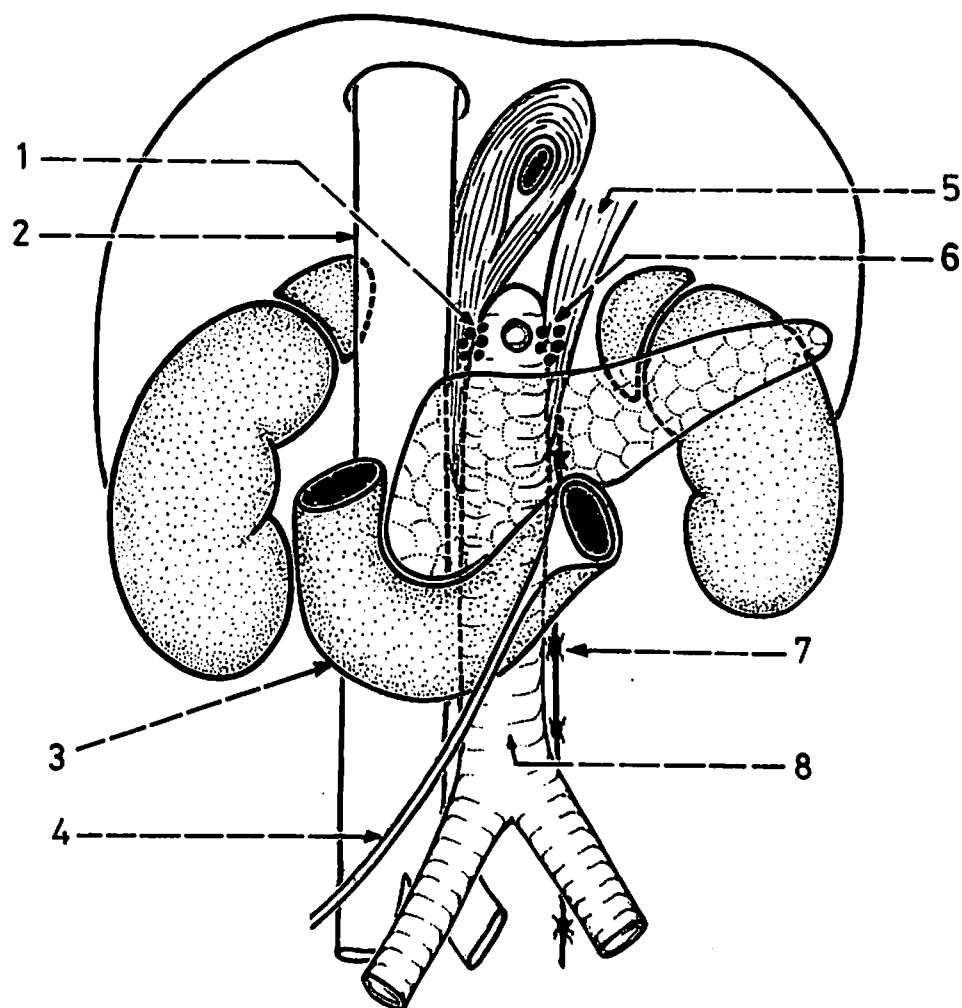


Fig.(301): ANTERIOR RELATIONS OF THE ABDOMINAL AORTA

The abdominal aorta is related anteriorly to the coeliac plexus of nerves (around the coeliac trunk), body of the pancreas (with the splenic and left renal veins in between), horizontal part of duodenum, root of the mesentery of the small intestine and only covered with peritoneum in its lowest part.

1. right coeliac ganglion.
2. inferior vena cava.
3. horizontal part of duodenum.
4. root of the mesentery of small intestine.
5. left crus of diaphragm.
6. left coeliac ganglion.
7. left sympathetic trunk.
8. lowest part of aorta (covered with peritoneum only).

Fig.(302): VEINS CROSSING IN FRONT AND BEHIND THE AORTA

The splenic and left renal veins cross in front of the upper part of the aorta, while the 3rd and 4th left lumbar veins cross behind its lower part.

1. superior mesenteric artery (arises between splenic and left renal veins).
2. inferior vena cava.
3. splenic vein.
4. left renal vein.
5. 3rd and 4th left lumbar veins.
6. inferior mesenteric vein (joins the splenic vein).

* The aorta is directly related to the inferior vena cava below but is separated from it by the right crus of the diaphragm above.

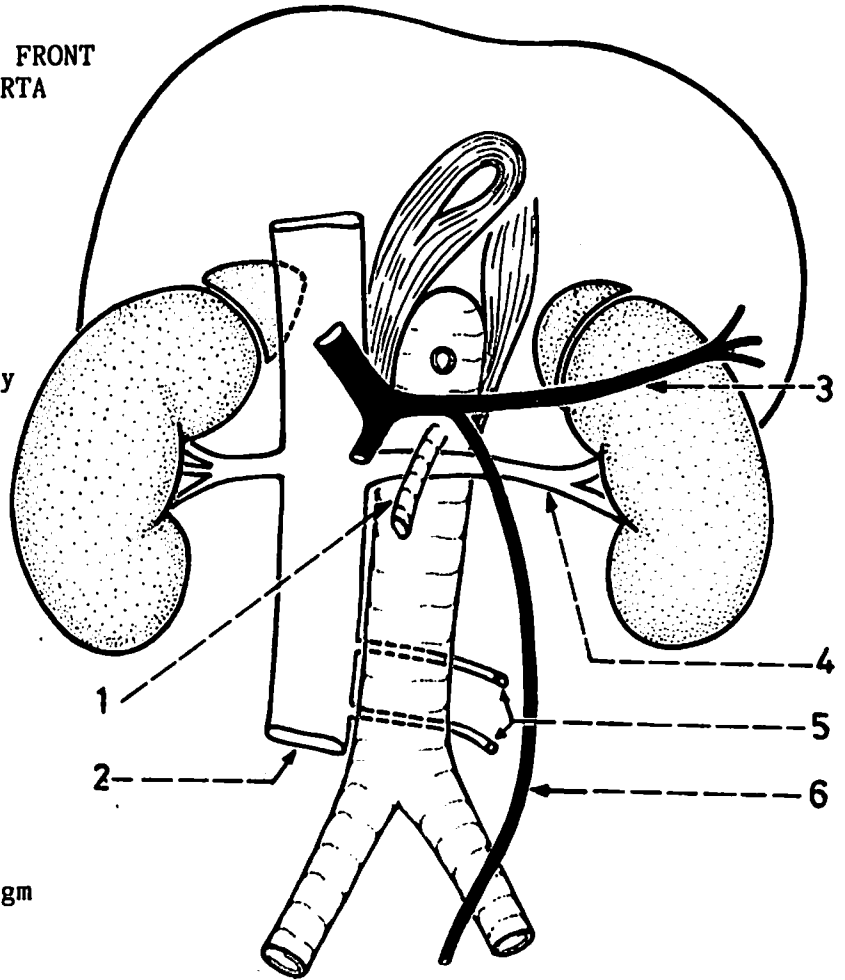


Fig.(303): SURFACE ANATOMY OF ABDOMINAL AORTA AND COMMON ILIAC ARTERIES

* The aorta is represented on the surface by a vertical line extending from a point placed in the median plane 1 inch above the transpyloric plane (point 1) down to a point placed $\frac{1}{2}$ inch below and to the left of the umbilicus (point 2).

* The common iliac artery is represented by the proximal 1/3 of a line drawn from point (2) to the midinguinal point (point 3); the distal 2/3 of this line represents the external iliac artery.

N.B.:

Point (2) representing the lower end of the aorta lies opposite the 4th lumbar vertebra which is on the level of the supra-cristal plane (the plane extending transversely between the highest points of the iliac crests on both sides).

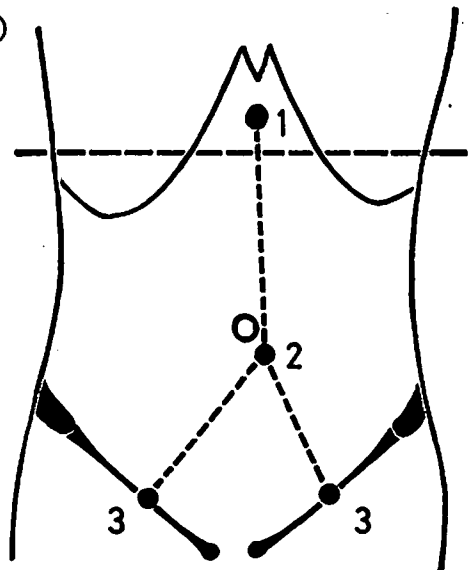


Fig.(304): BRANCHES OF THE AORTA

These may be grouped into 4 sets: ventral (coeliac, superior mesenteric and inferior mesenteric), lateral (inferior phrenic, middle suprarenal, renal and gonadal), dorsal (lumbar and median sacral) and terminal (common iliac).

1. coeliac trunk.
2. superior mesenteric artery.
3. lumbar arteries.
4. median sacral artery.
5. inferior phrenic artery.
6. middle suprarenal artery.
7. renal artery.
8. gonadal artery (testicular or ovarian).
9. inferior mesenteric artery.
10. common iliac artery.

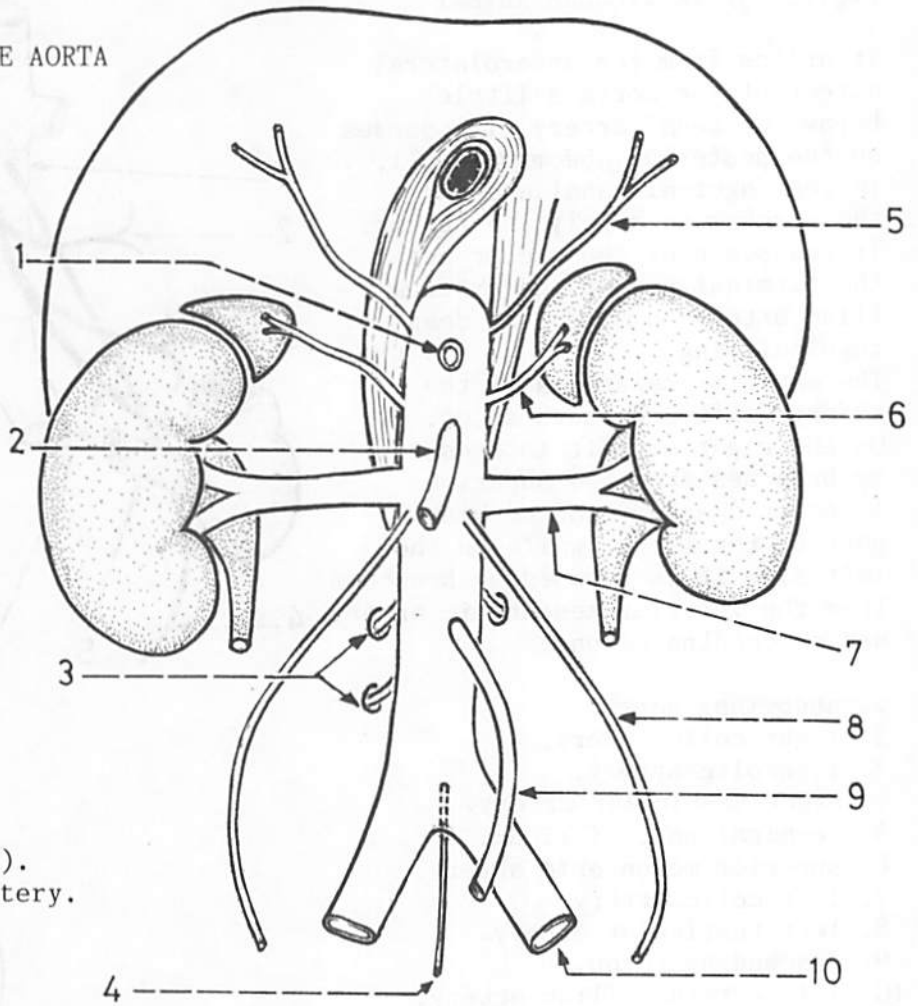


Fig.(305): INFERIOR PHRENIC ARTERY

It arises from the side of the uppermost part of the aorta. It runs upwards and laterally in front of the crus of the diaphragm close to the medial border of the suprarenal gland. It ramifies on the inferior surface of the diaphragm behind the oesophagus (on the left side) and behind the I.V.C. (on the right side).

1. inferior vena cava.
2. right inferior phrenic artery.
3. right suprarenal gland.
4. left suprarenal gland.
5. left inferior phrenic artery.

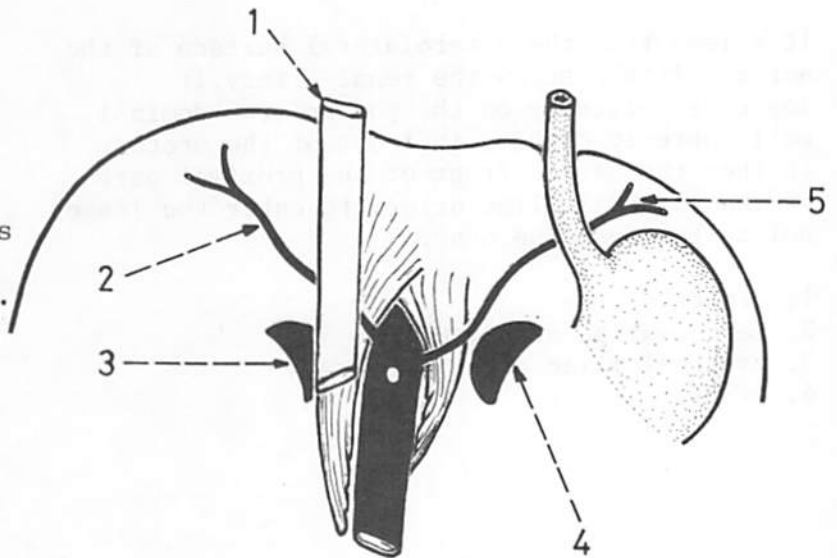
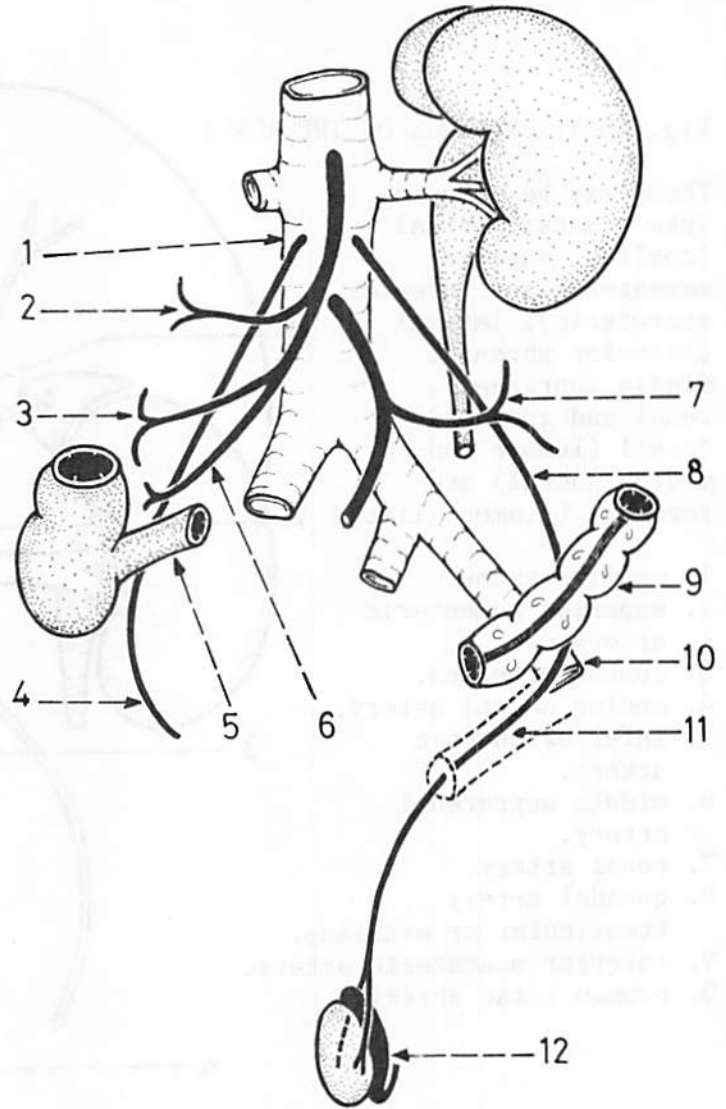


Fig.(306): TESTICULAR ARTERY

It arises from the anterolateral aspect of the aorta a little below the renal artery. It courses on the posterior abdominal wall, in the inguinal canal and in the scrotum to supply the testis. It crosses over the ureter and the terminal end of the external iliac artery to enter the deep inguinal ring.

The anterior relations of the artery differ on both sides. On the right side it is crossed by branches from the superior mesenteric artery and terminal part of the ileum, while on the left side it is crossed by branches from the inferior mesenteric artery and descending colon.



1. abdominal aorta.
2. right colic artery.
3. ileocolic artery.
4. right testicular artery.
5. terminal part of ileum.
6. superior mesenteric artery.
7. left colic artery.
8. left testicular artery.
9. descending colon.
10. left external iliac artery.
11. inguinal canal.
12. testis.

Fig.(307): OVARIAN ARTERY

It arises from the anterolateral surface of the aorta a little below the renal artery. It descends obliquely on the posterior abdominal wall where it crosses in front of the ureter. It then crosses in front of the proximal part of the external iliac artery to enter the lesser pelvis to reach the ovary.

1. ureter.
2. left ovarian artery.
3. external iliac artery.
4. ovary.

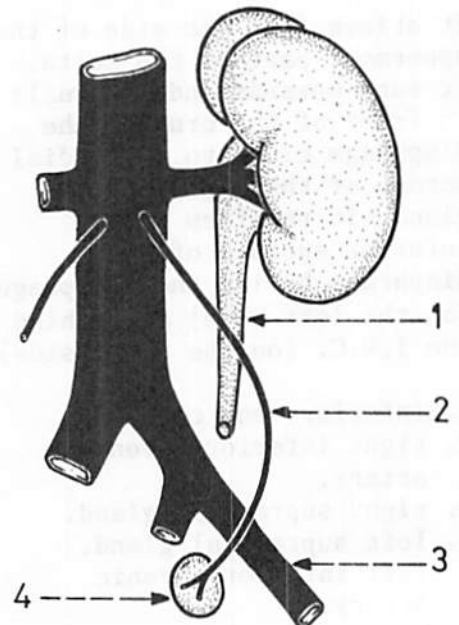
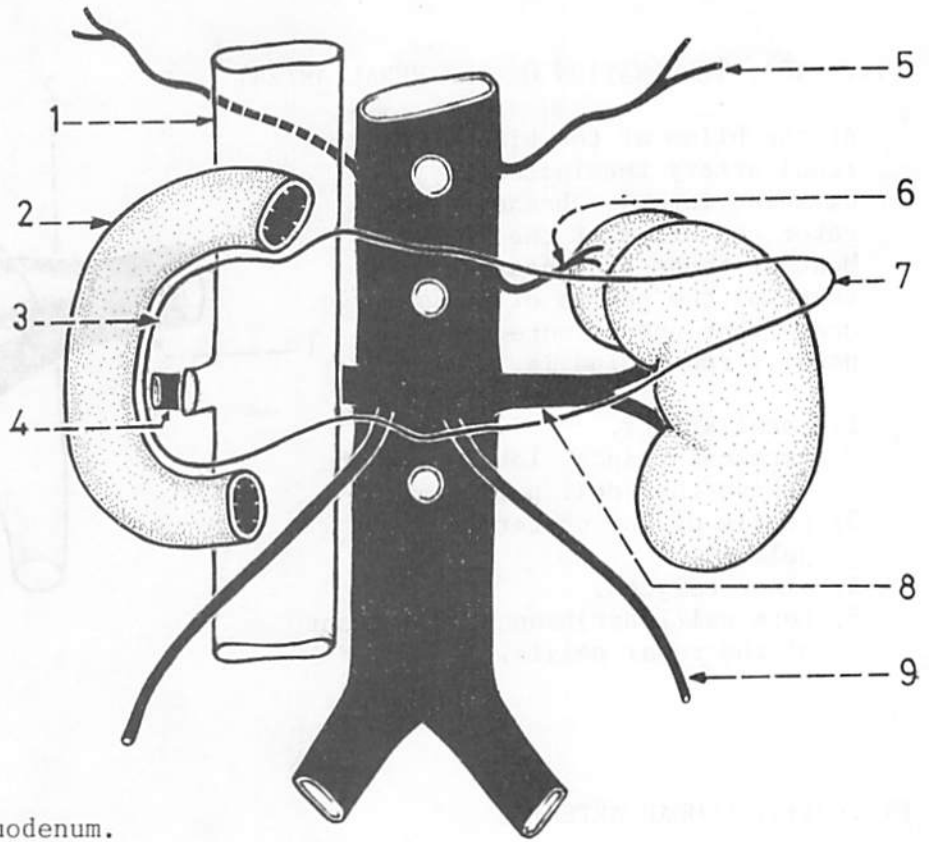


Fig.(308): RENAL ARTERY

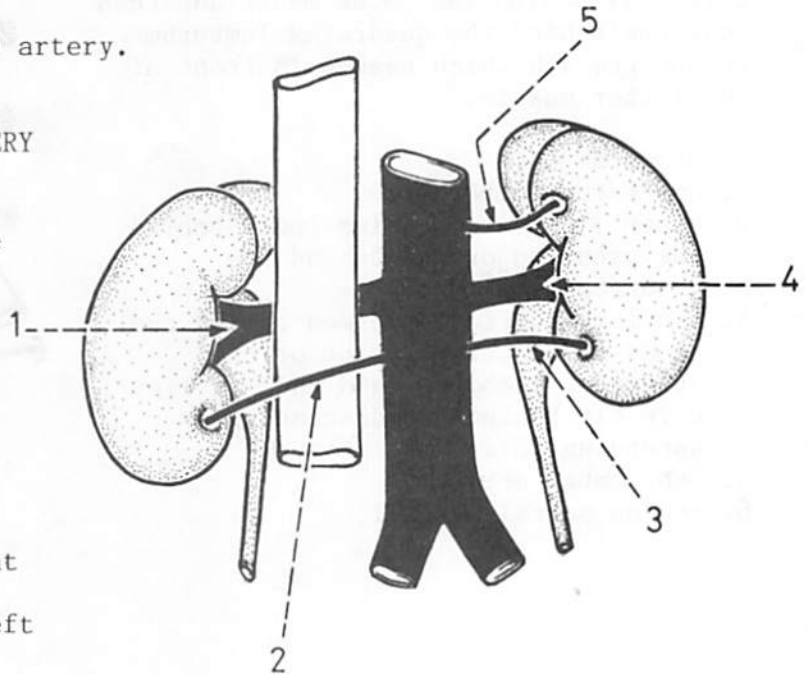
The renal artery arises from the side of the aorta just below the superior mesenteric artery, opposite the 2nd L.V. It runs laterally at right angle to the aorta to reach the kidney. The anterior relations of the artery differ on both sides. The right artery runs behind the head of pancreas, I.V.C., right renal vein and descending part of duodenum, while the left runs behind the body of pancreas and left renal vein.



1. inferior vena cava.
2. descending part of duodenum.
3. head of pancreas.
4. right renal artery.
5. left inferior phrenic artery.
6. left middle suprarenal artery.
7. tail of pancreas.
8. left renal artery.
9. left testicular (or ovarian) artery.

Fig.(309): ACCESSORY RENAL ARTERY

An accessory renal artery may arise from the aorta just above or below the renal artery. It pierces the upper or the lower pole (usually the lower) but does not enter through the hilum of the kidney.



1. right renal artery (behind I.V.C.).
2. accessory renal artery to the right kidney (in front of I.V.C.).
3. accessory renal artery to left kidney (to lower pole).
4. left renal artery.
5. accessory renal artery to the upper pole of left kidney.

* An accessory artery does not replace the main artery but is present in addition to it.

Fig.(310): TERMINATION OF THE RENAL ARTERY

At the hilum of the kidney the renal artery terminates by dividing into 4-5 branches which enter the hilum of the kidney. Most of these branches run in front of the pelvis of the ureter but one or more branches usually run behind it.

1. renal artery.
2. terminal branch (lobar) passing behind the renal pelvis.
3. pelvis of the ureter (renal pelvis).
4. minor calyces.
5. terminal(lobar)branches in front of the renal pelvis.

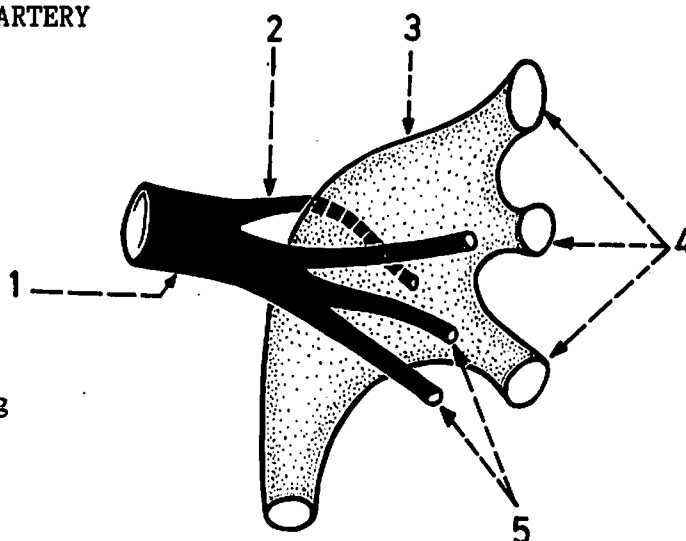


Fig.(311): LUMBAR ARTERIES

These are 5 pairs of arteries of which 4 pairs arise from the back of the aorta, while the 5th arises from the median sacral artery. The upper 4 arteries run laterally behind the psoas major and then continue behind the quadratus lumborum except the 4th which passes in front of the latter muscle.

1. psoas major.
2. quadratus lumborum.
3. upper 3 lumbar arteries (pass behind the psoas major and behind the quadratus lumborum).
4. 4th lumbar artery (passes behind the psoas major but in front of the quadratus lumborum, and thus it lies directly behind the descending or ascending colon).
5. 5th lumbar artery.
6. median sacral artery.

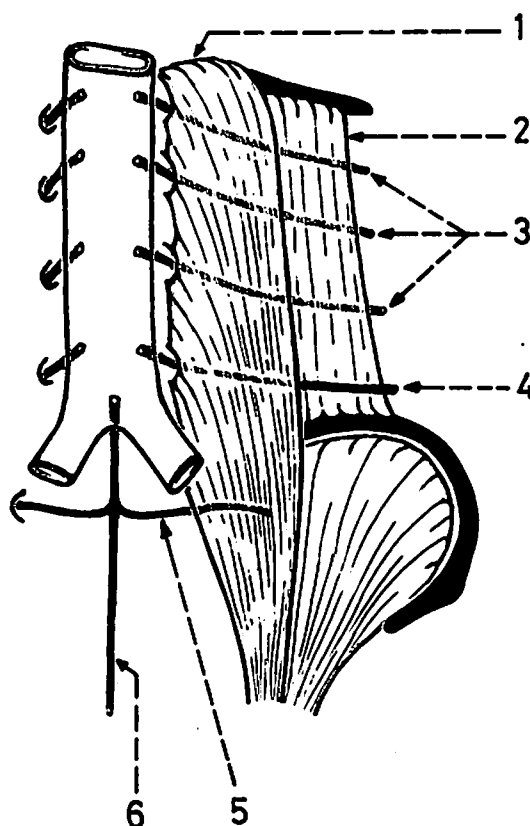
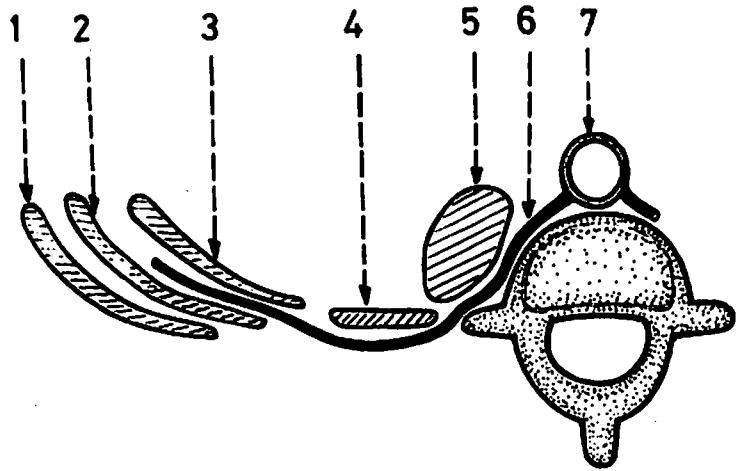


Fig.(312):COURSE OF A LUMBAR ARTERY

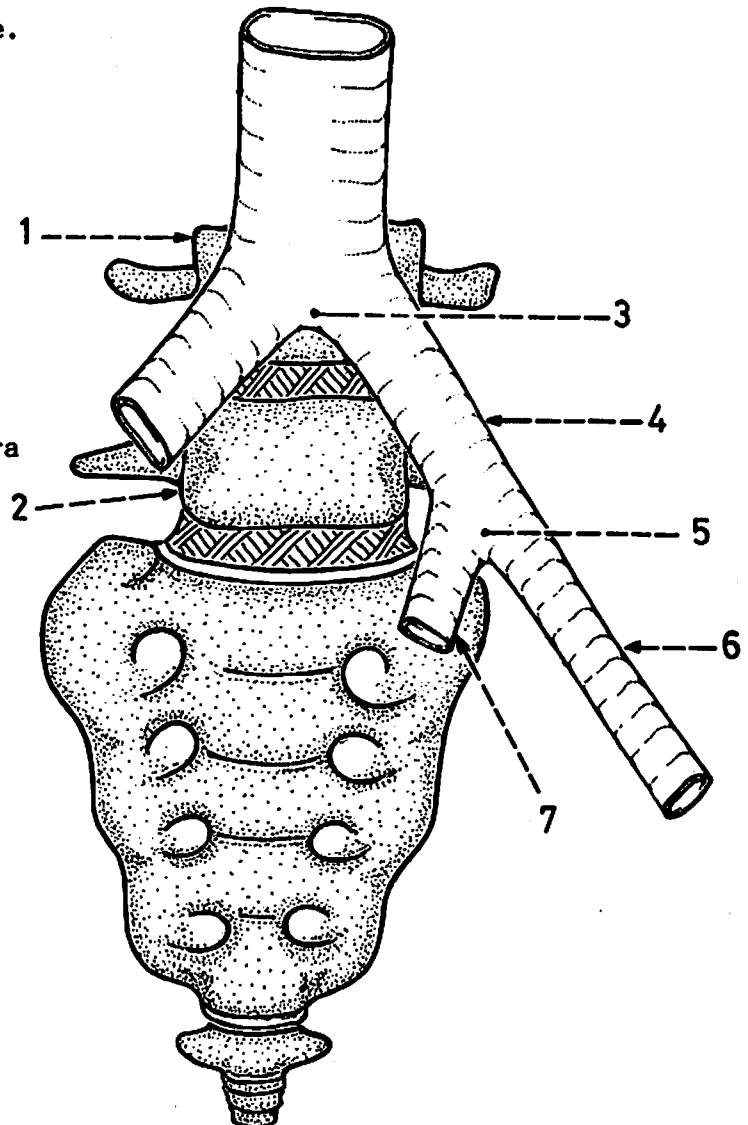
This is the course of one of the upper 3 lumbar arteries. It passes laterally behind the psoas major and quadratus lumborum and then continues between the transversus abdominis and the internal oblique muscles. In the antero-lateral abdominal wall the lumbar arteries anastomose with the lower posterior intercostals, subcostal, ilio-lumbar, inferior epigastric and ascending branch of the deep circumflex iliac.



1. external oblique muscle.
2. internal oblique muscle.
3. transversus abdominis muscle.
4. quadratus lumborum muscle.
5. psoas major muscle.
6. lumbar artery (arising from the back of the aorta).
7. abdominal aorta.

Fig.(313): COMMON ILIAC ARTERY

The common iliac artery is one of the 2 terminal branches of the aorta. It arises in front of the 4th lumbar vertebra and ends opposite the disc between the 5th L.V. and sacrum (opposite the sacro-iliac joint) by dividing into external and internal iliac branches.



1. 4th lumbar vertebra.
2. 5th lumbar vertebra.
3. termination of abdominal aorta.
4. left common iliac artery.
5. termination of the left common iliac artery.
6. external iliac artery.
7. internal iliac artery.

Fig.(314): RELATIONS OF THE COMMON ILIAC ARTERY

The right artery is related to the ureter and sympathetic fibres in front, and to the sympathetic trunk and beginning of I.V.C. behind. The left artery is related to the ureter, sympathetic fibres and inferior mesenteric artery and vein in front and to the sympathetic trunk only behind.

1. right ureter crossing the termination of the common iliac artery.
2. inferior vena cava (begins behind the right common iliac artery).
3. left sympathetic trunk.
4. inferior mesenteric artery.
5. inferior mesenteric vein.
6. left ureter crossing in front of the termination of the common iliac artery.
7. left common iliac artery.
8. superior hypogastric plexus receiving sympathetic fibres from both sides.
9. right sympathetic trunk.

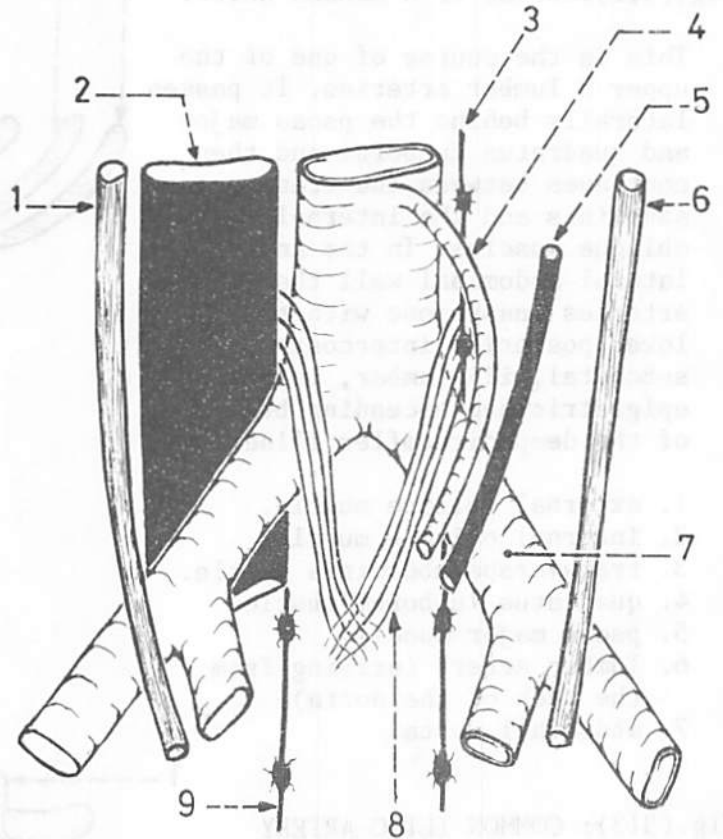
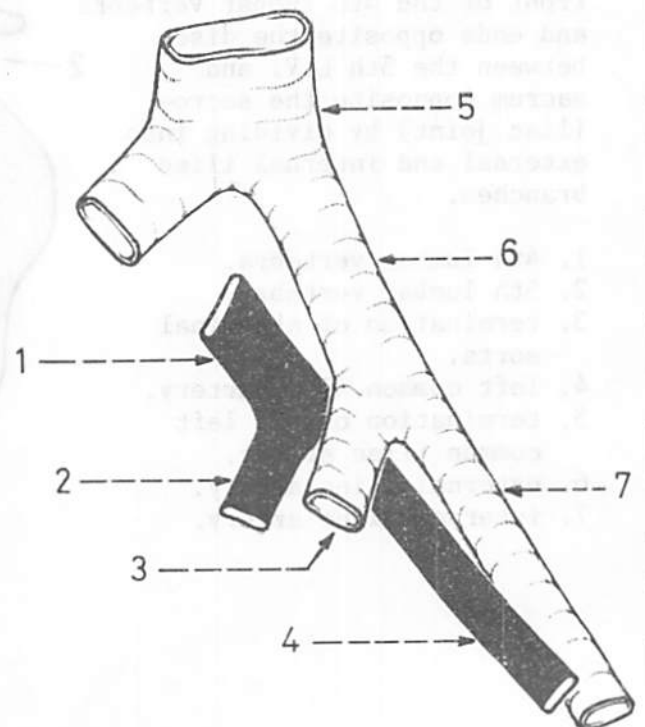


Fig.(315): EXTERNAL ILIAC ARTERY AND VEIN

The external iliac vein lies on the medial side of its artery and ends opposite the sacro-iliac joint by uniting with the internal iliac vein to form the common iliac vein. The internal iliac vein runs vertically behind its artery.

1. common iliac vein.
2. internal iliac vein.
3. internal iliac artery.
4. external iliac vein.
5. end of abdominal aorta.
6. common iliac artery.
7. external iliac artery.



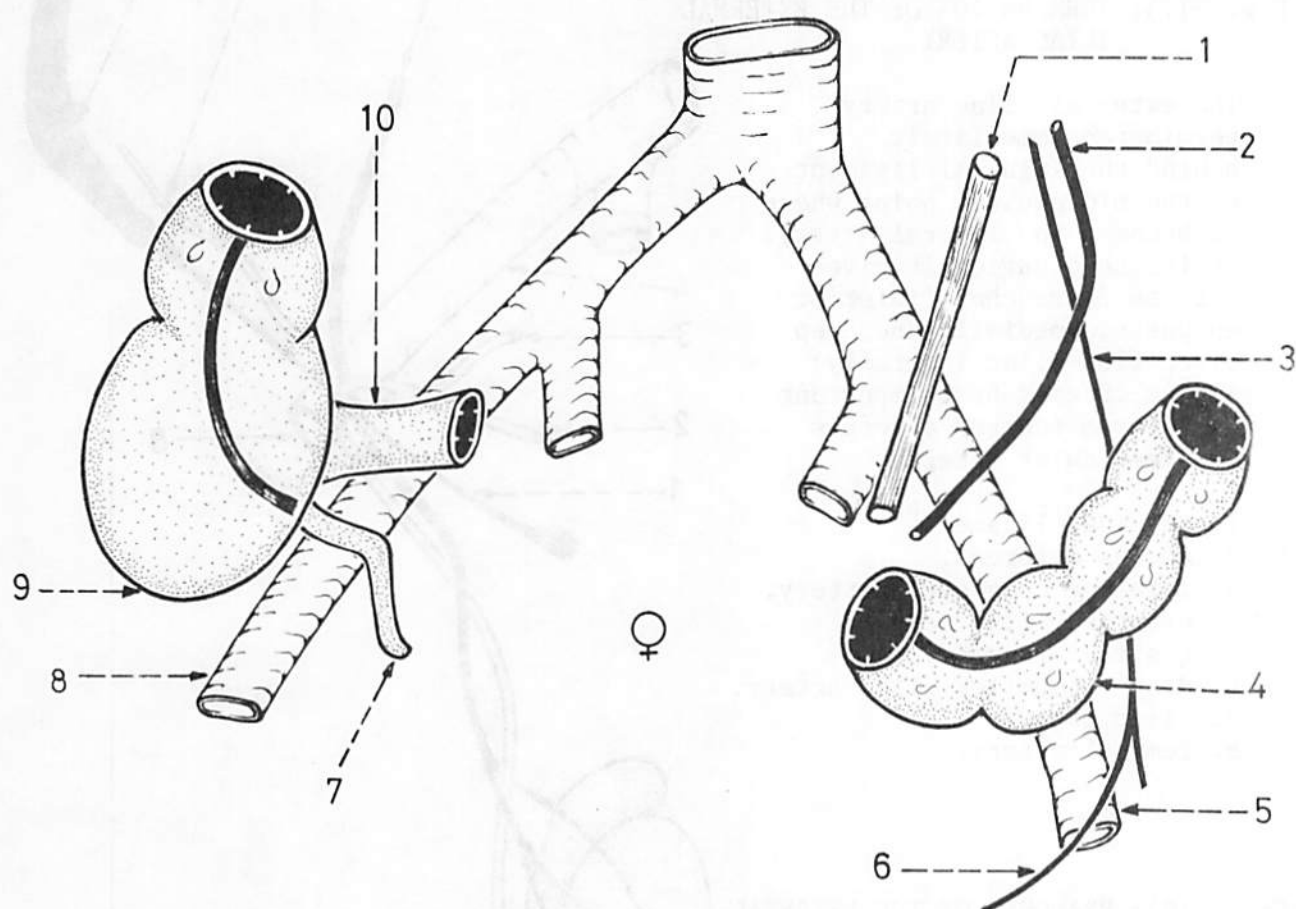


Fig.(316): ANTERIOR RELATIONS OF THE EXTERNAL ILIAC ARTERIES

The anterior relations which are common to the arteries of both sides are: ureter (at its beginning), ovarian artery in the female (near its origin), testicular artery in the male (near its termination), ductus deferens or round ligament of the uterus (near its termination) and genital branch of genitofemoral nerve (near its termination). However, there are differences between both sides. The right artery is related anteriorly to the terminal part of ileum and appendix, while the left artery is related to the sigmoid colon.

1. left ureter.
2. left ovarian artery.
3. genitofemoral nerve.
4. sigmoid colon (its beginning).
5. termination of the external iliac artery (just behind the inguinal ligament).
6. genital branch of genitofemoral nerve.
7. vermiform appendix.
8. right external iliac artery.
9. caecum.
10. terminal part of the ileum.

Fig.(317): TERMINATION OF THE EXTERNAL ILIAC ARTERY

The external iliac artery terminates immediately behind the inguinal ligament at the midinguinal point where it becomes the femoral artery. At its termination it gives off its 2 branches (inferior epigastric medially and deep circumflex iliac laterally), and is crossed by 2 important structures (ductus deferens and testicular artery).

1. inguinal ligament.
2. ductus deferens.
3. inferior epigastric artery.
4. external iliac artery.
5. testicular artery.
6. deep circumflex iliac artery.
7. iliac crest.
8. femoral artery.

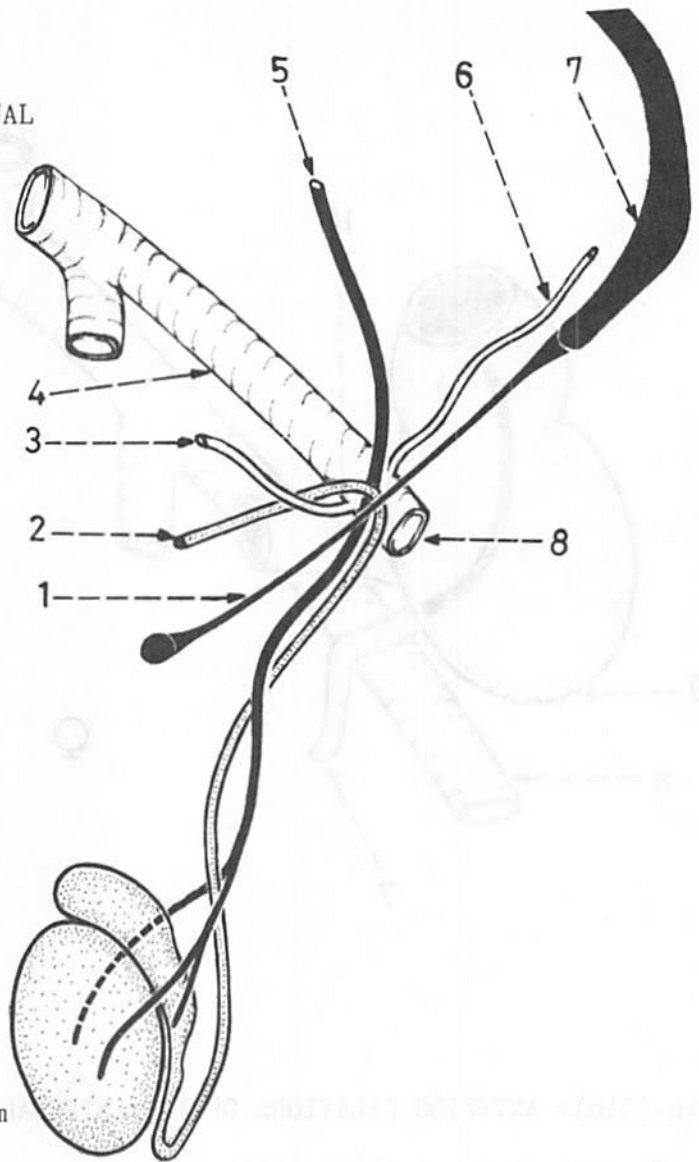
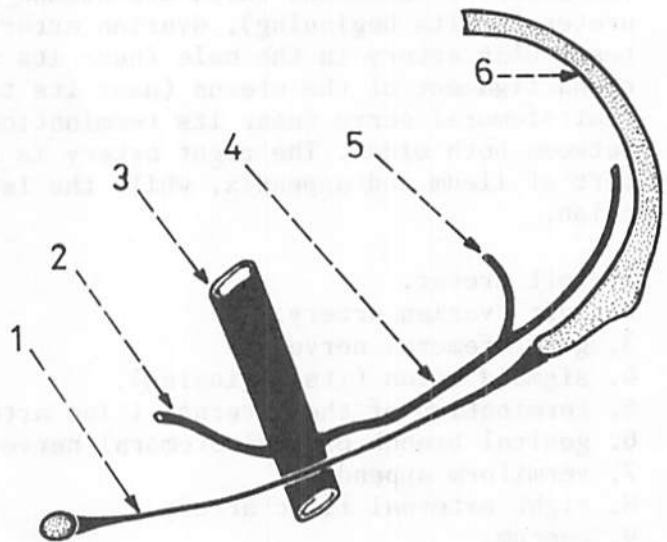


Fig.(318): BRANCHES OF THE EXTERNAL ILIAC ARTERY

It gives off 2 branches only from its terminal end just behind the inguinal ligament; these are the inferior epigastric and deep circumflex iliac arteries.

1. inguinal ligament.
2. inferior epigastric artery (passes upwards and medially to reach the rectus sheath).
3. external iliac artery.
4. deep circumflex iliac artery (runs laterally behind and parallel to the inguinal ligament to reach the iliac crest).
5. ascending lumbar branch of the deep circumflex iliac artery.
6. iliac crest.



INFERIOR VENA CAVA

Fig.(319): COURSE OF INFERIOR VENA CAVA

The I.V.C. begins in front of the body of the 5th L.V., and ascends on the right side of the aorta. It perforates the right part of the central tendon of the diaphragm opposite the 8th T.V. to enter the chest cavity.

1. inferior vena cava.
2. right phrenic nerve passing through the opening for I.V.C.
3. right cupola of diaphragm.
4. duodenum situated in front of the middle part of I.V.C.
5. right common iliac vein.
6. left common iliac vein (longer and more horizontal than the right).
7. 5th lumbar vertebra.
8. abdominal aorta dividing into 2 common iliac arteries with the right artery passing in front of the origin of I.V.C.

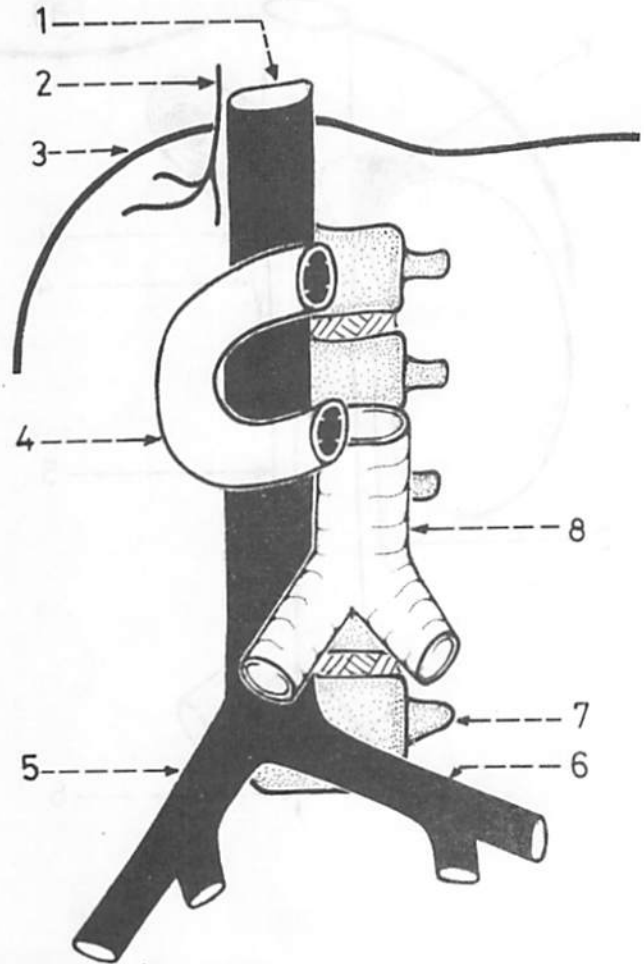
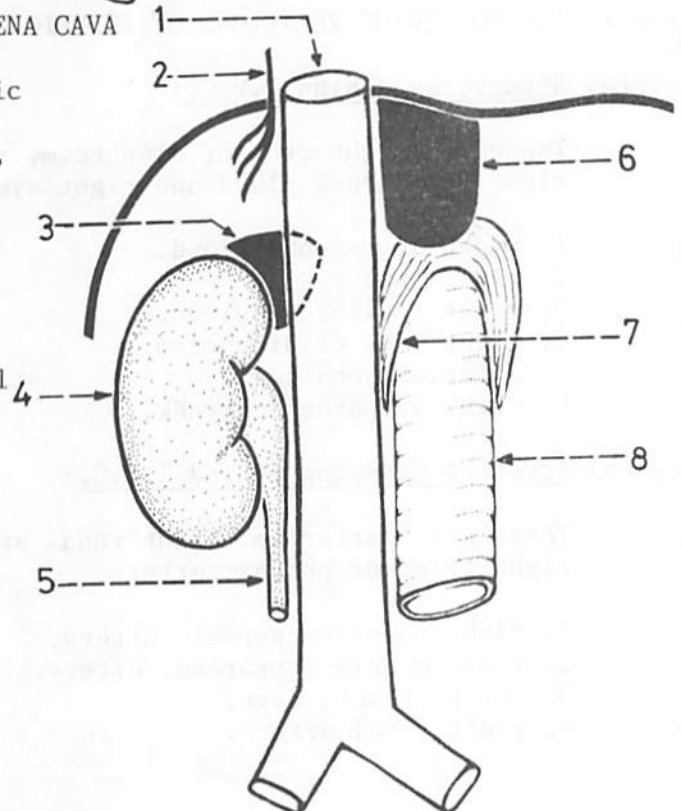


Fig.(320): SIDE RELATIONS OF INFERIOR VENA CAVA

The I.V.C. is related to right phrenic nerve, medial border of right kidney and right ureter (on its right side), and to caudate lobe of the liver, right crus of diaphragm and abdominal aorta (on its left side).

1. inferior vena cava.
2. right phrenic nerve.
3. right suprarenal gland (its medial part lies behind I.V.C.).
4. right kidney.
5. right ureter.
6. caudate lobe of the liver.
7. right crus of diaphragm.
8. abdominal aorta.



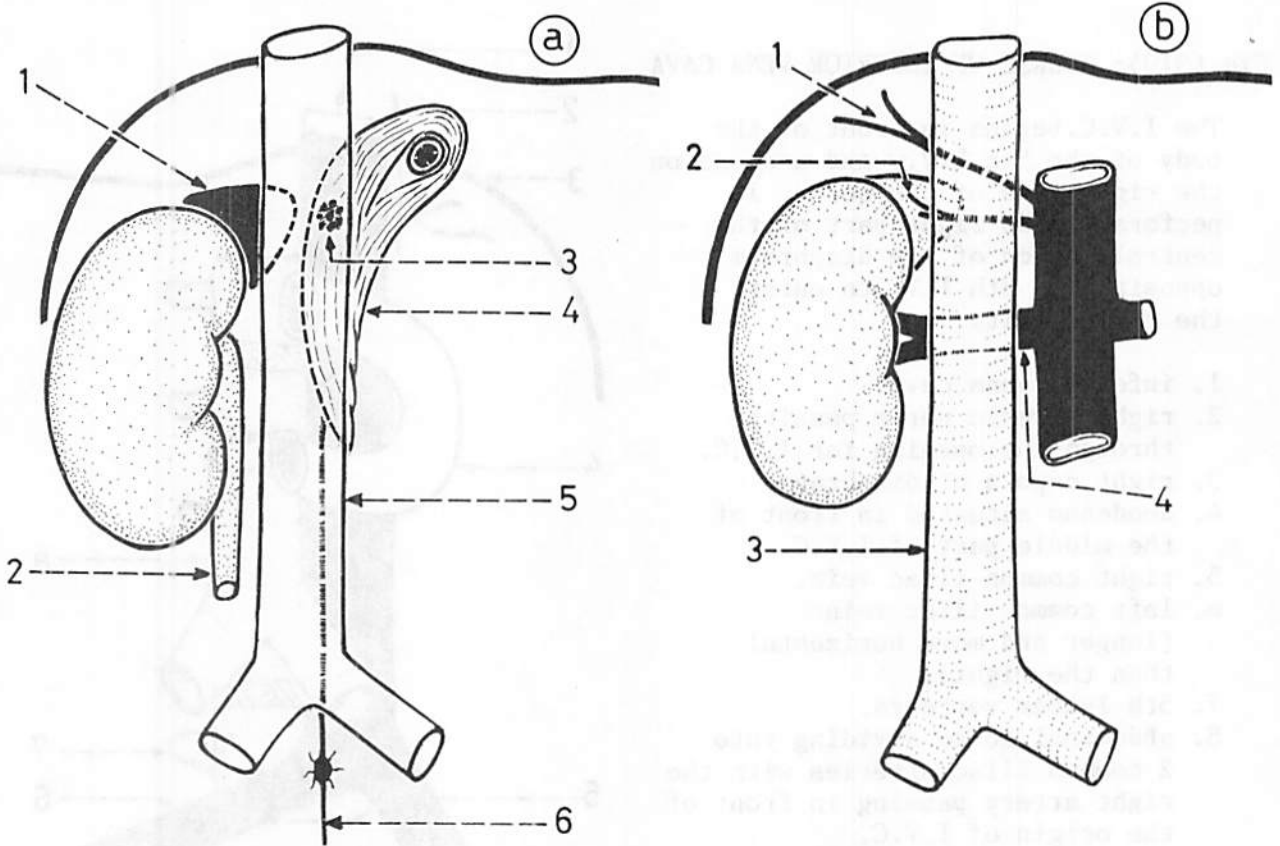


Fig.(321): POSTERIOR RELATIONS OF INFERIOR VENA CAVA

(a) Structures behind I.V.C.:

These are right crus of diaphragm, right coeliac ganglion, medial part of right suprarenal gland and right sympathetic trunk.

1. right suprarenal gland.
2. right ureter.
3. right coeliac ganglion.
4. right crus of diaphragm.
5. inferior vena cava.
6. right sympathetic trunk.

(b) Arteries crossing behind I.V.C.:

These are 3 arteries: right renal artery, right middle suprarenal artery and right inferior phrenic artery.

1. right inferior phrenic artery.
2. right middle suprarenal artery.
3. inferior vena cava.
4. right renal artery.

Fig.(322): ANTERIOR RELATIONS OF INFERIOR VENA CAVA

It is related to the following structures from above downwards: back of right lobe of liver, portal vein (with the epiploic foramen in between), superior part of duodenum, head of pancreas, horizontal part of duodenum, right gonadal artery, root of the mesentery (with the superior mesenteric artery in it) and right common iliac artery.

1. arrow in the epiploic foramen.
2. bile duct.
3. inferior vena cava.
4. portal vein.
5. duodenum.
6. head of pancreas.
7. right gonadal artery (testicular or ovarian).
8. root of the mesentery of small intestine.
9. right common iliac artery (in front of the beginning of I.V.C.).

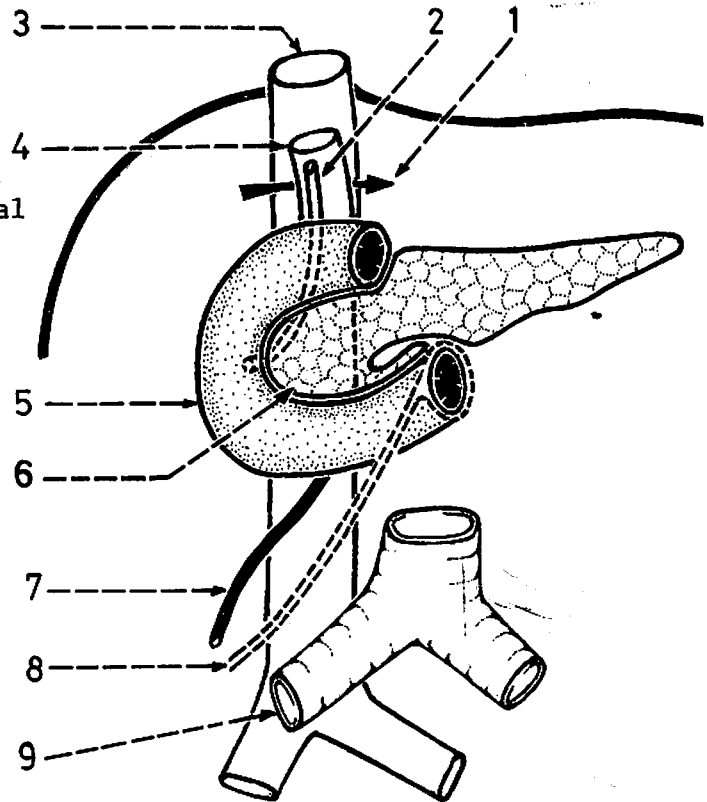


Fig.(323): SURFACE ANATOMY OF THE INFERIOR VENA CAVA

It is represented by a vertical line extending from the sternal end of the 6th right costal cartilage (point 1) down to a point on the transtuberular plane 1 inch to the right of the median plane (point 2).

N.B.:

The transtuberular plane extends between the tubercles of iliac crest on both sides, opposite the 5th L.V.

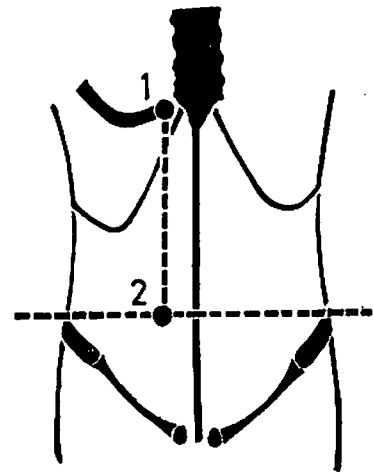


Fig.(324):TRIBUTARIES OF INFERIOR VENA CAVA

It receives the following tributaries:
common iliac, lumbar, right testicular
or ovarian, renal, right suprarenal,
inferior phrenic, hepatic and azygos
vein.

1. hepatic veins.
2. inferior phrenic vein.
3. right suprarenal vein (not the left).
4. right gonadal vein (not the left).
5. azygos vein.
6. renal vein.
7. lumbar veins.
8. ascending lumbar vein.

* All tributaries of I.V.C. are bilateral except the testicular or ovarian (from right side), suprarenal (from right side) and azygos vein (it is not bilateral).

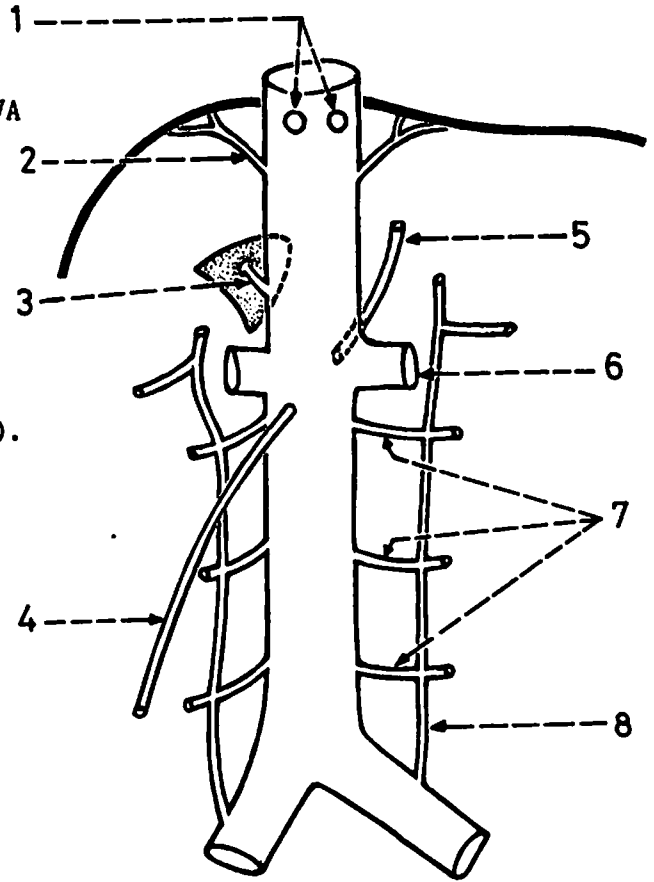


Fig.(325): LUMBAR VEINS

These are 4 veins on each side, the lower 3 of which end in the inferior vena cava while the 1st lumbar vein joins the ascending lumbar vein.

The ascending lumbar vein ascends in front of the transverse processes of the lumbar vertebrae, one on each side. It connects the lumbar veins together and ends by joining the subcostal vein to form the azygos vein on the right side and the inferior hemiazygos on the left side.

1. azygos vein.
2. inferior vena cava.
3. connection between the azygos vein and back of I.V.C.
4. subcostal vein.
5. the 4 lumbar veins.
6. right ascending lumbar vein.
7. inferior hemiazygos vein.
8. subcostal vein.
9. left lumbar veins.
10. left ascending lumbar vein.
11. left common iliac vein.

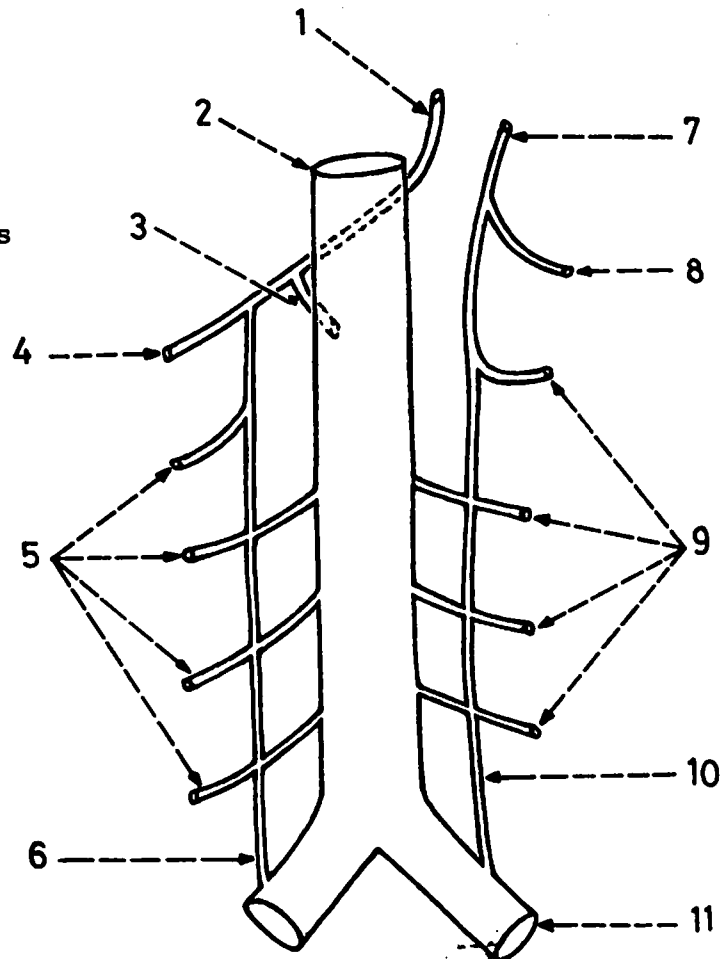
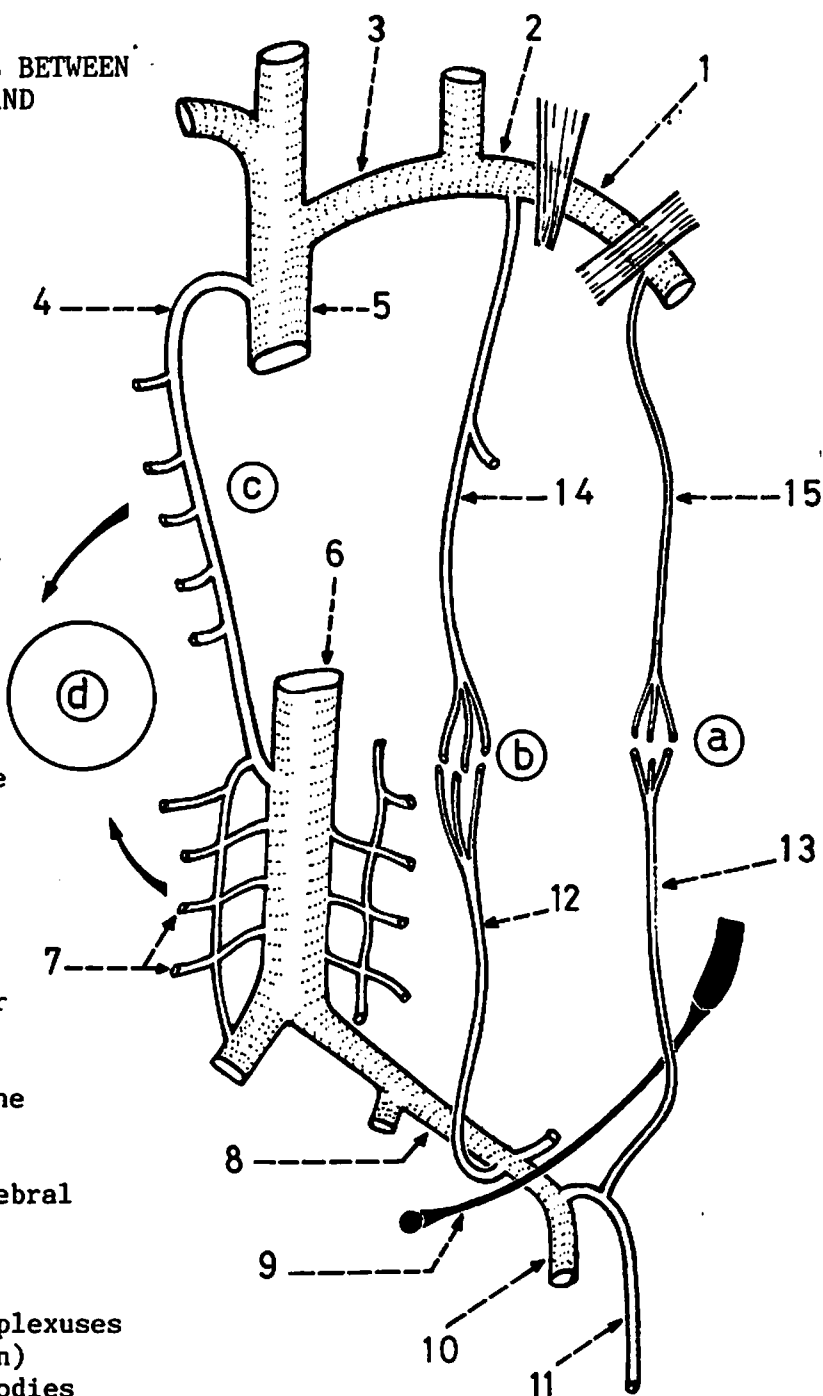


Fig.(326): SITES OF ANASTOMOSES BETWEEN
SUPERIOR VENA CAVA AND
INFERIOR VENA CAVA

1. axillary vein.
2. subclavian vein.
3. left innominate vein.
4. azygos vein.
5. superior vena cava.
6. inferior vena cava.
7. lumbar veins.
8. external iliac vein.
9. inguinal ligament.
10. femoral vein.
11. great saphenous vein.
12. inferior epigastric vein.
13. superficial epigastric vein.
14. superior epigastric vein.
15. lateral thoracic vein.

- (a) anastomosis in the superficial fascia of the anterior abdominal wall (thoraco-epigastric vein).
- (b) deep anastomosis in the rectus sheath (between the superior and inferior epigastric veins).
- (c) direct anastomosis via the azygos vein.
- (d) anastomosis via the vertebral plexuses of veins.

* Note that the vertebral plexuses of veins (veins of Batson) surround the vertebral bodies and line the vertebral canal and are connected below with the lumbar veins and above with the posterior intercostal veins. Through these connections the inferior vena cava communicates with the superior vena cava.



PORTAL CIRCULATION

Fig.(327): COURSE OF THE PORTAL VEIN

The portal vein begins behind the neck of pancreas by the union of the superior mesenteric and splenic veins. It ascends in front of the inferior vena cava to reach the porta hepatis where it ends by dividing into right and left branches. In its lower part it lies behind the superior part of the duodenum, while its upper part lies in the free border of the lesser omentum.

1. right and left branches of the portal vein.
2. porta hepatis.
3. inferior vena cava.
4. arrow in the epiploic foramen (between the portal vein and I.V.C.).
5. portal vein.
6. superior part of duodenum.
7. splenic vein.
8. inferior mesenteric vein.
9. beginning of portal vein (opposite 2nd L.V.).
10. superior mesenteric vein.

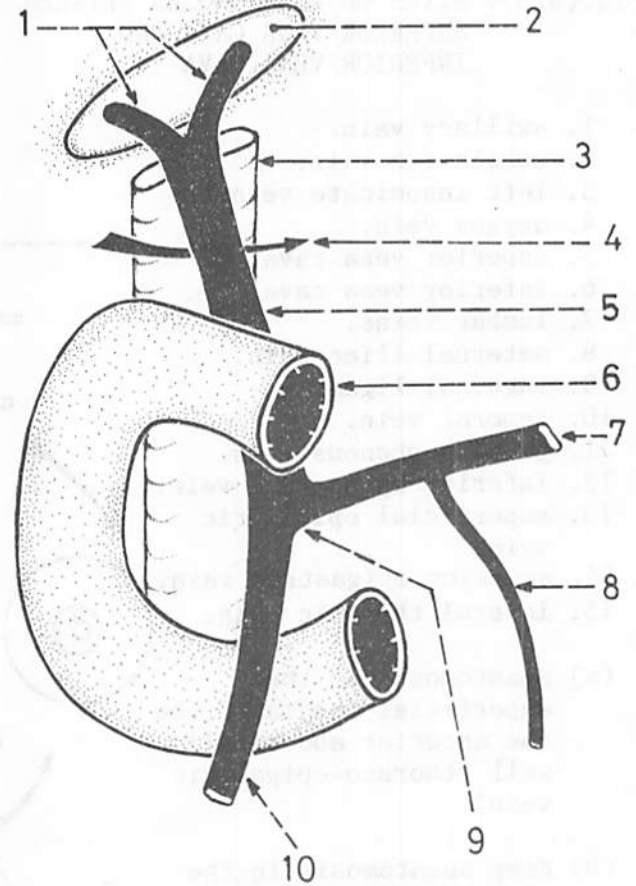


Fig.(328): RELATIONS OF THE PORTAL VEIN

The I.V.C. is the only posterior relation to the portal vein, only separated from it above by the epiploic foramen. The anterior relations are: superior part of the duodenum, bile duct, hepatic artery and gastroduodenal artery.

1. portal vein.
2. inferior vena cava.
3. superior part of duodenum.
4. hepato-pancreatic ampulla.
5. bile duct.
6. hepatic artery.
7. upper part of gastroduodenal artery (the lower part lies between the duodenum and head of pancreas).

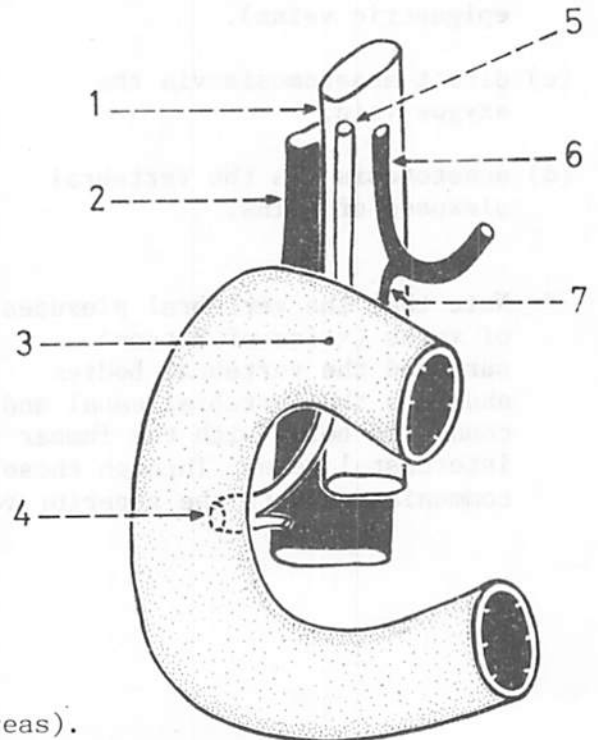
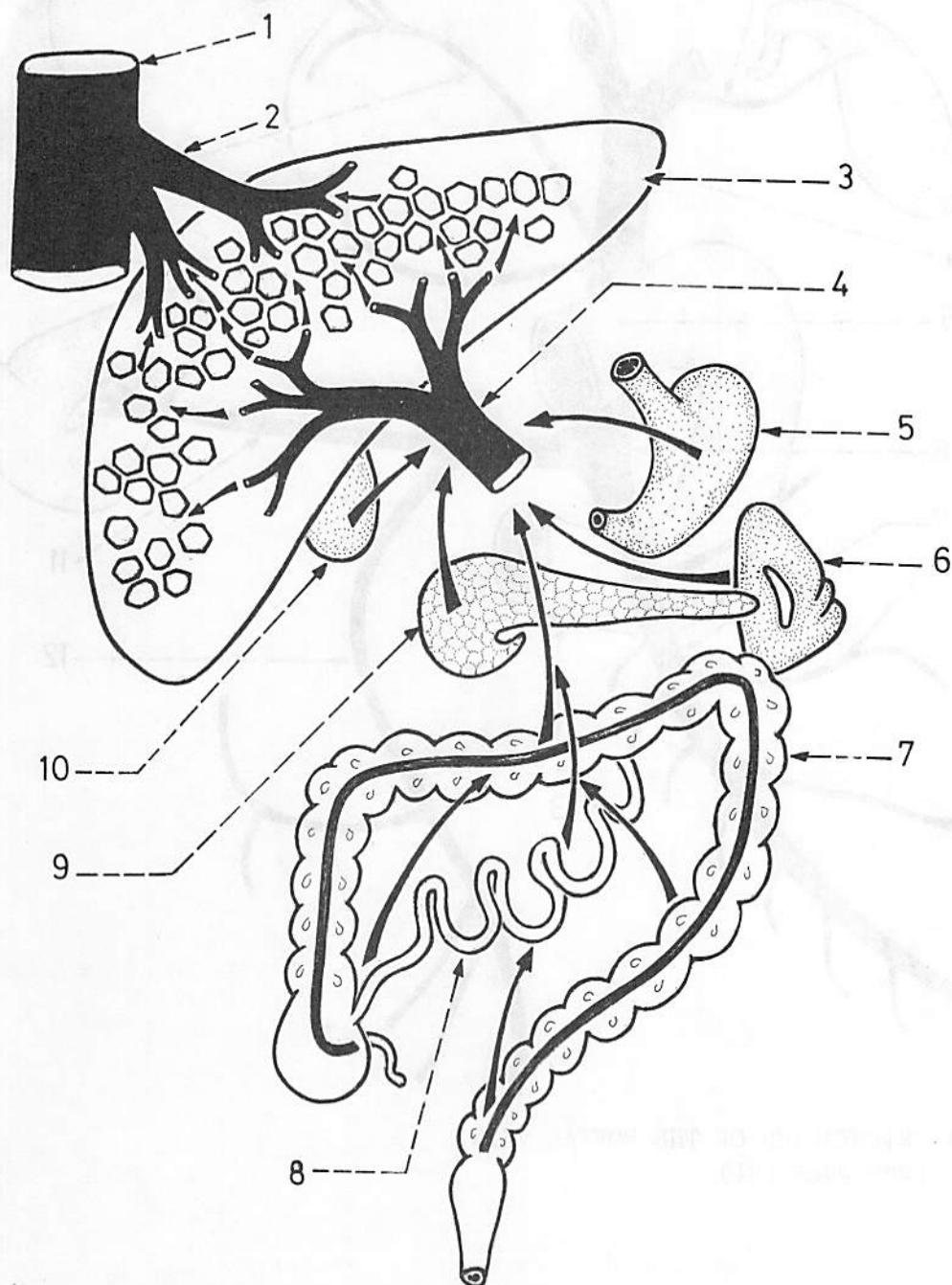


Fig.(329): PORTAL CIRCULATION

Venous blood from the stomach and intestine as well as from the spleen, pancreas and gall bladder is conveyed to the liver via the portal vein. In the liver, the portal vein divides repeatedly and its blood finally reaches the liver sinusoids. This blood is then collected by the hepatic veins to reach the I.V.C.

1. inferior vena cava.
2. hepatic vein.
3. liver.
4. portal vein.
5. stomach.

6. spleen.
7. large intestine.
8. small intestine.
9. pancreas.
10. gall bladder.



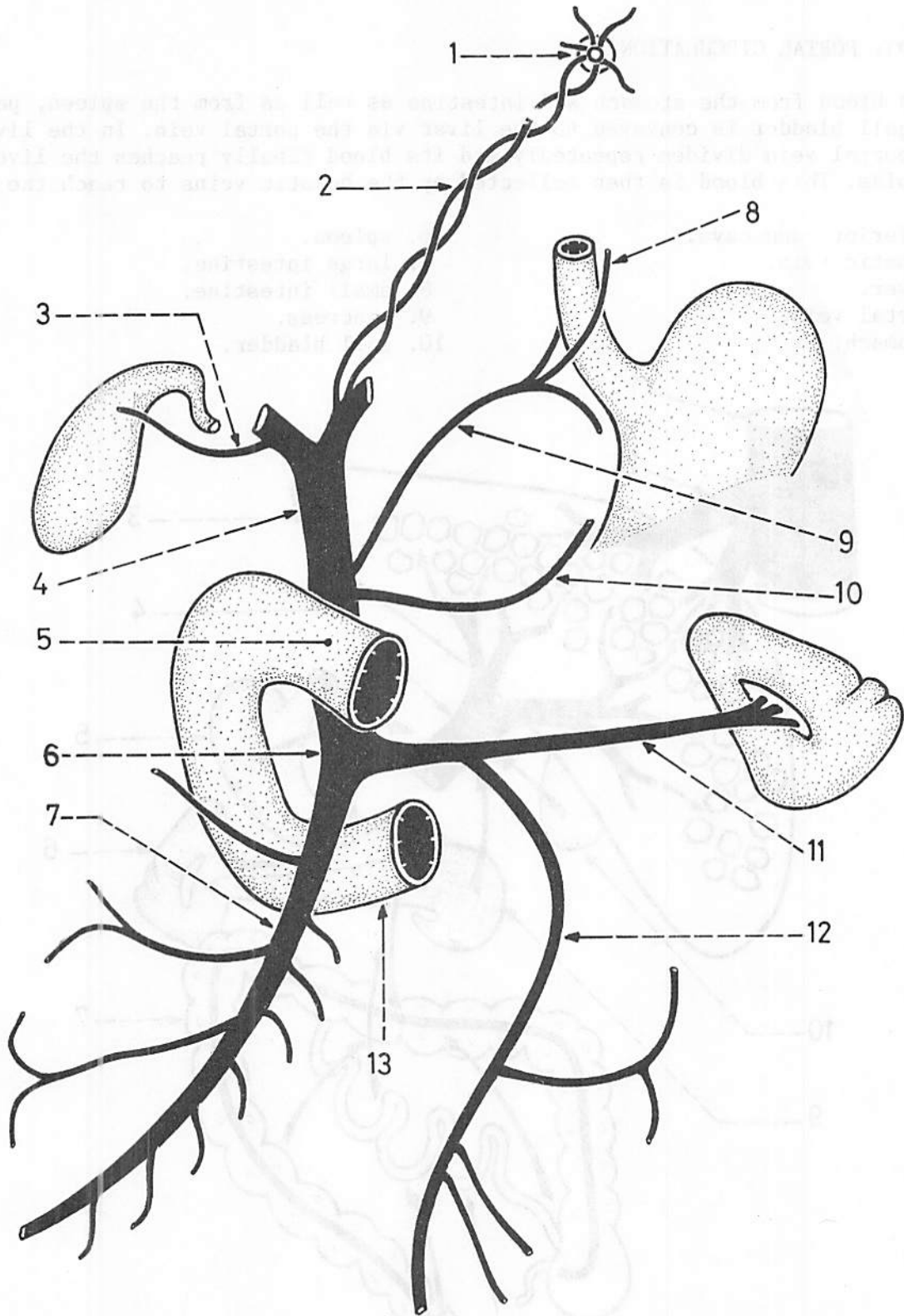


Fig.(330): TRIBUTARIES OF THE PORTAL VEIN
(see page 181)

Fig.(330): TRIBUTARIES OF THE PORTAL VEIN

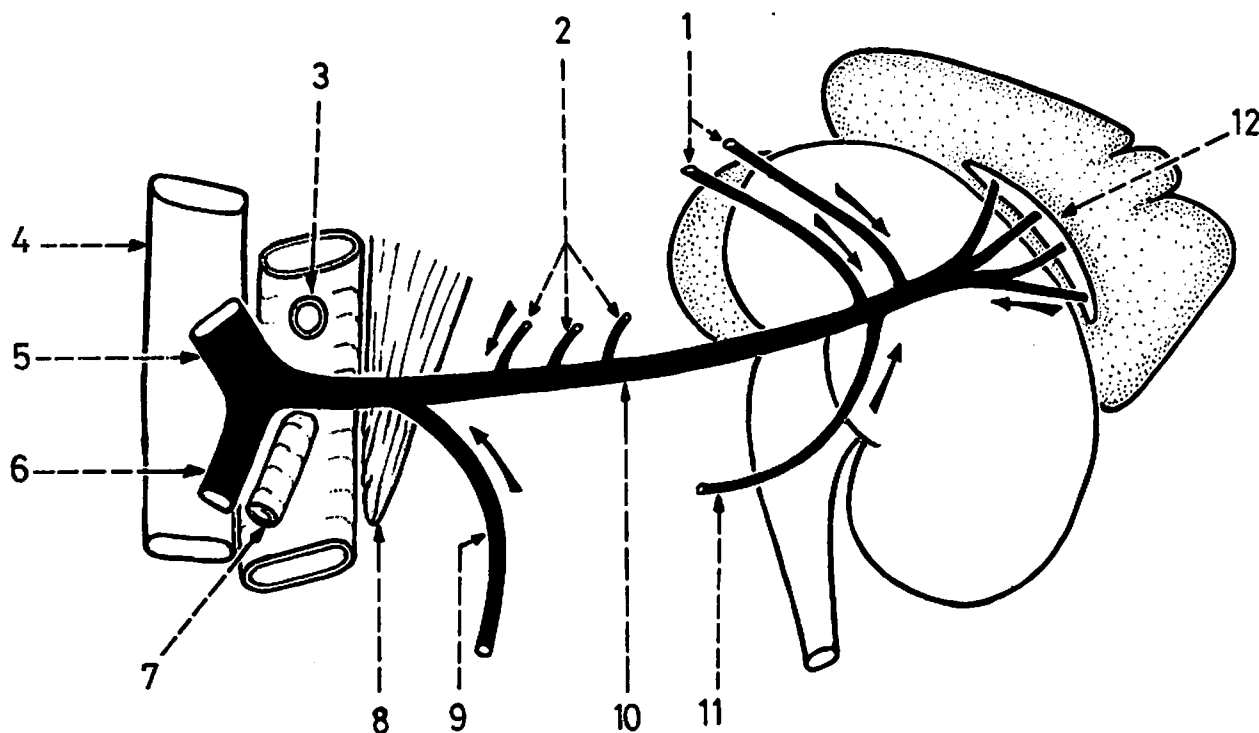
It receives 6 tributaries: 2 at its origin (splenic and superior mesenteric), 2 join its trunk (right and left gastric) and 2 join its right and left branches (paraumbilical and cystic).

- | | |
|---|---|
| 1. umbilicus. | 7. superior mesenteric vein. |
| 2. paraumbilical veins (surround ligamentum teres and end in the left branch of portal vein). | 8. oesophageal branches of left gastric vein. |
| 3. cystic vein (joins the right branch of portal vein). | 9. left gastric vein. |
| 4. portal vein. | 10. right gastric vein. |
| 5. superior part of duodenum. | 11. splenic vein. |
| 6. origin of portal vein. | 12. inferior mesenteric vein. |
| | 13. horizontal part of duodenum. |

Fig.(331): TRIBUTARIES OF THE SPLENIC VEIN

These are: short gastric, left gastro-epiploic, pancreatic, inferior mesenteric and tributaries from the spleen.

- | | |
|------------------------------|--------------------------------|
| 1. short gastric veins. | 7. superior mesenteric artery. |
| 2. pancreatic veins. | 8. right crus of diaphragm. |
| 3. coeliac trunk. | 9. inferior mesenteric vein. |
| 4. inferior vena cava. | 10. splenic vein. |
| 5. portal vein. | 11. left gastro-epiploic vein. |
| 6. superior mesenteric vein. | 12. hilum of spleen. |



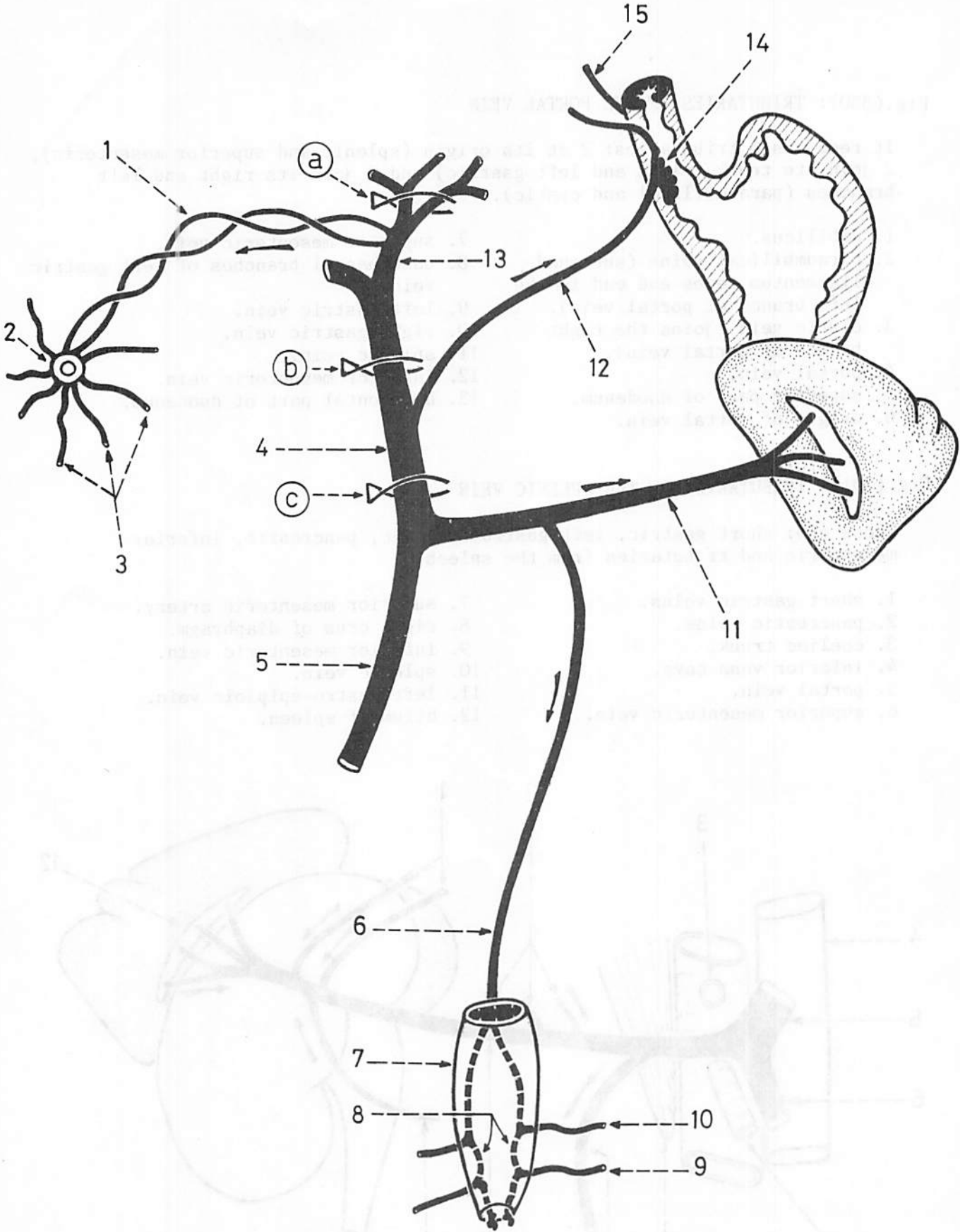


Fig.(332): SITES OF PORTO-CAVAL ANASTOMOSIS
(see page 183)

Fig.(332): SITES OF PORTO-CAVAL ANASTOMOSIS
(main sites)

There are 3 main sites of porto-caval (porto-systemic) anastomosis: in the lower end of the oesophagus, around the umbilicus and in the wall of the anal canal.

- * In the lower end of oesophagus: between the tributaries of left gastric vein (portal) and those belonging to the azygos system (systemic). Enlargement of this anastomosis leads to oesophageal varices.
- * Around the umbilicus: between the para-umbilical veins (portal) and veins of the anterior abdominal wall (systemic). Enlargement of this anastomosis leads to caput medusae.
- * In the wall of the anal canal: between superior rectal vein (portal) and the middle and inferior rectal veins (systemic). Enlargement of this anastomosis results in piles (haemorrhoids).

- | | |
|------------------------------|----------------------------------|
| 1. para-umbilical veins. | 9. inferior rectal vein. |
| 2. umbilicus. | 10. middle rectal vein. |
| 3. caput medusae. | 11. splenic vein. |
| 4. portal vein. | 12. left gastric vein. |
| 5. superior mesenteric vein. | 13. left branch of portal vein. |
| 6. superior rectal vein. | 14. site of oesophageal varices. |
| 7. rectum and anal canal. | 15. oesophageal veins. |
| 8. site of piles. | |

(a), (b), (c) represent sites of obstruction along the course of the portal vein. Obstruction at (a) leads to caput medusae, oesophageal varices and piles. Obstruction at (b) leads to oesophageal varices and piles. Obstruction at (c) leads only to piles.

Fig.(333): LESS EFFECTIVE SITES OF
PORTO-CAVAL ANASTOMOSIS

These are 3 sites:

- (1) at the bare area of the liver: between the veins of the liver (portal) and veins of the diaphragm (systemic).
- (2), (3) behind the ascending and descending colon: between the veins of the colon (portal) and veins of posterior abdominal wall (systemic).

- * Note that the anastomoses at these 3 sites are retroperitoneal and are less effective as routes for collateral circulation in case of obstruction of the portal vein.

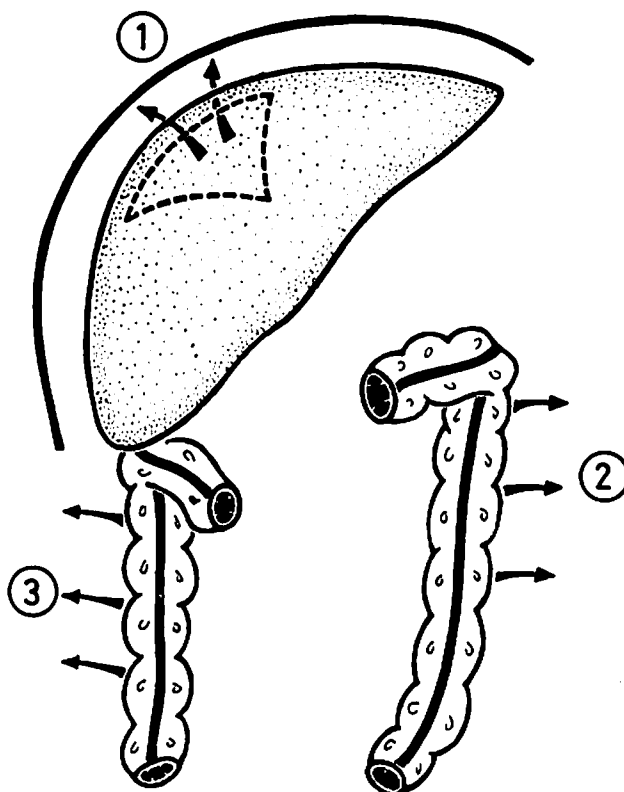
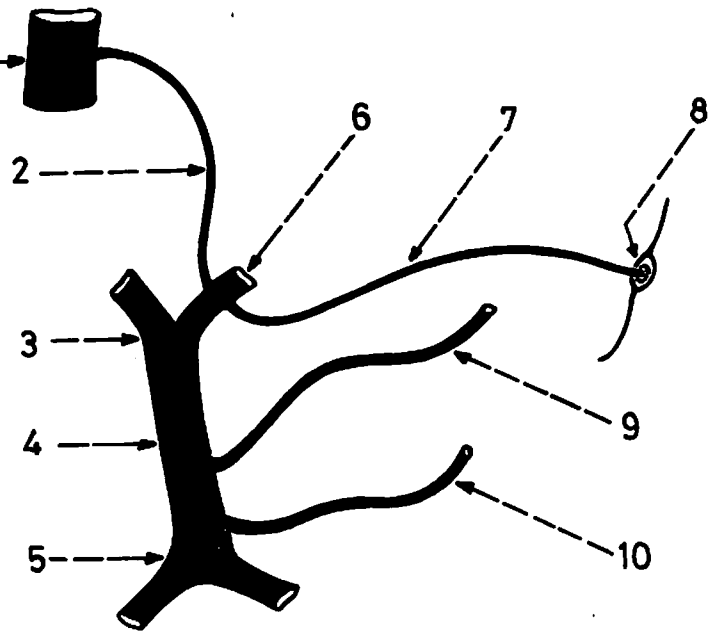


Fig.(334): LIGAMENTS ATTACHED TO THE PORTAL VEIN

These are the ligamentum teres and ligamentum venosum both of which are attached to the left branch of portal vein.

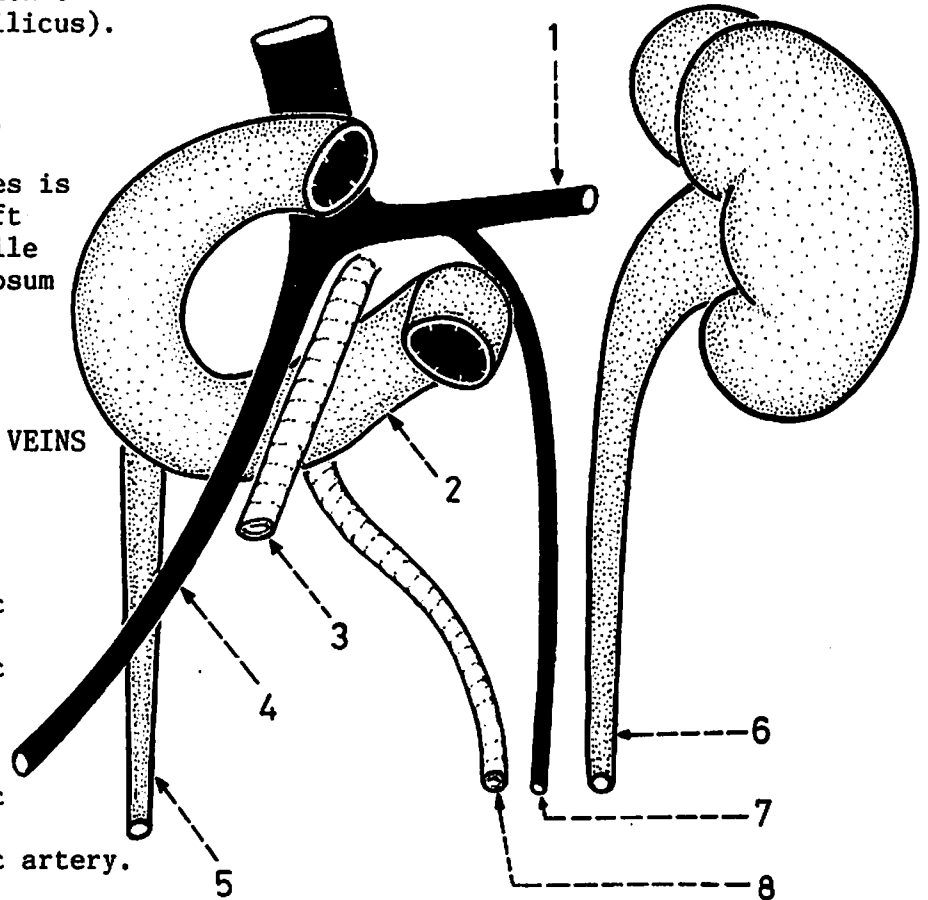
1. inferior vena cava.
2. ligamentum venosum (extends from the left branch of portal vein to I.V.C.).
3. right branch of portal vein.
4. portal vein (2 inches long).
5. beginning of portal vein.
6. left branch of portal vein.
7. ligamentum teres (extends from the left branch of portal vein to umbilicus).
8. umbilicus.
9. left gastric vein.
10. right gastric vein.



* The ligamentum teres is the obliterated left umbilical vein, while the ligamentum venosum is the obliterated ductus venosus.

Fig.(335): MESENTERIC VEINS

1. splenic vein.
2. horizontal part of duodenum.
3. superior mesenteric artery.
4. superior mesenteric vein.
5. right ureter.
6. left ureter.
7. inferior mesenteric vein.
8. inferior mesenteric artery.



* The superior mesenteric vein accompanies its artery all through, and crosses the right ureter and horizontal part of the duodenum.

* The inferior mesenteric vein is widely separated from its artery in its upper part. It runs parallel to the left ureter and comes in relation to the duodeno-jejunal flexure.

* The 2 mesenteric veins lie lateral to their respective arteries.

NERVES ON THE POSTERIOR ABDOMINAL WALL

Fig.(336): LUMBAR PLEXUS

It is formed inside the psoas major by the ventral rami of the upper 4 lumbar nerves. Its branches are: ilio-hypogastric, ilio-inguinal, genitofemoral, lateral cutaneous nerve of thigh, femoral, obturator and a contribution to the lumbo-sacral trunk.

1. iliohypogastric nerve (L.1).
2. ilio-inguinal nerve (L.1).
3. genitofemoral nerve (L.1,2).
4. lateral cutaneous nerve of thigh (L.2,3).
5. femoral nerve (L.2,3,4).
6. obturator nerve (L.2,3,4).
7. accessory obturator nerve (L.3,4).
8. lumbo-sacral trunk (L.4,5).

* Note that the obturator and femoral nerves arise from the same roots (L.2,3,4); the obturator arises from their ventral divisions while the femoral arises from their dorsal divisions.

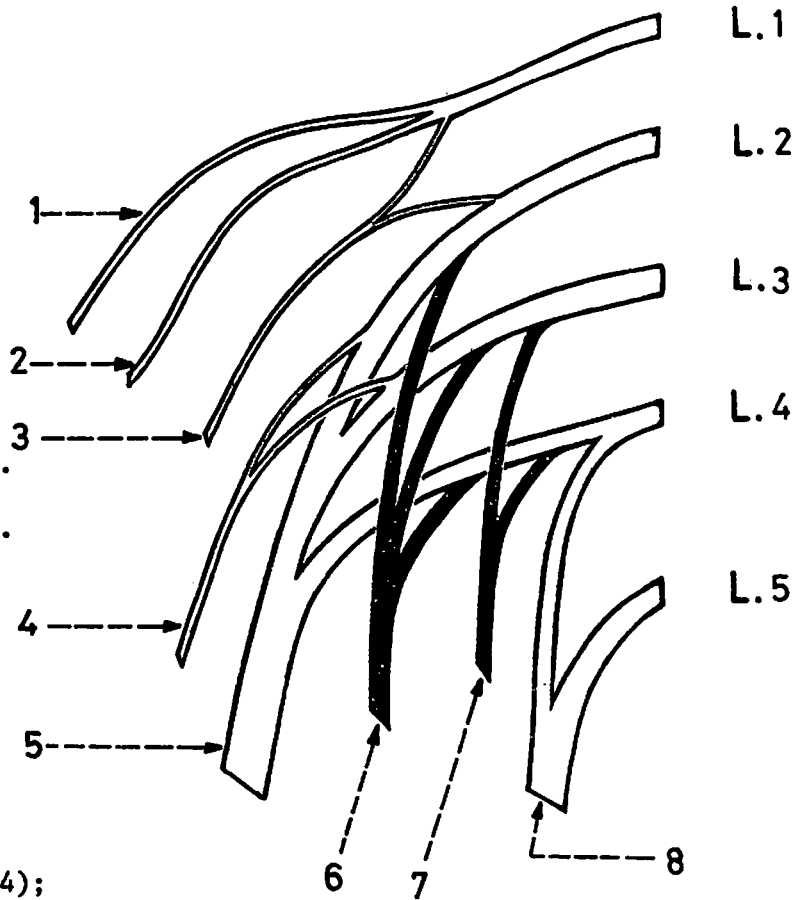


Fig.(337): FEMORAL AND ACCESSORY OBTURATOR NERVES

The femoral nerve emerges at the lower part of the lateral border of psoas major between it and the iliacus. Here it gives off branches to the iliacus and a branch to the pectineus.

The accessory obturator nerve is frequently present and descends on the medial border of psoas major above the superior ramus of pubis to supply the pectineus.

1. femoral nerve.
2. iliacus.
3. psoas major.
4. accessory obturator nerve.
5. nerve to pectineus.
6. obturator nerve (emerges below the superior ramus of pubis).

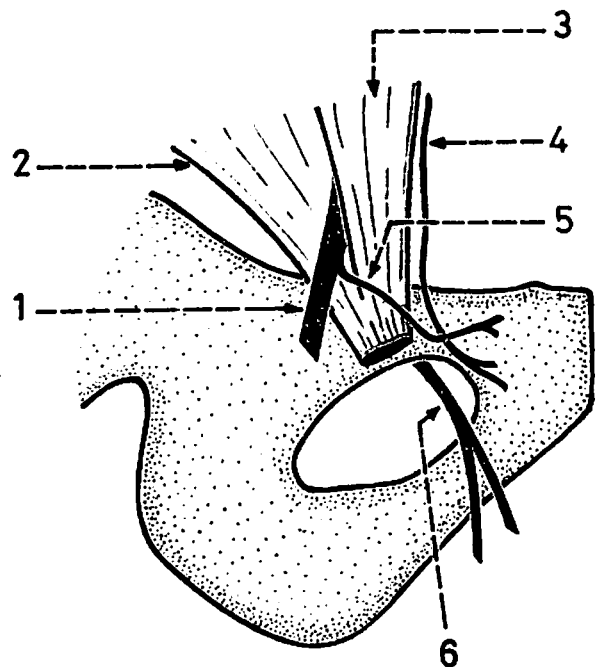


Fig.(338): RELATIONS OF BRANCHES OF THE LUMBAR PLEXUS TO PSOAS MAJOR

Along the lateral border of the muscle emerge: iliohypogastric, ilio-inguinal, lateral cutaneous nerve of thigh and femoral nerves. In front of the muscle emerges the genitofemoral nerve. Along the medial border of the muscle emerge: obturator nerve and lumbosacral trunk.

1. genitofemoral nerve.
2. lumbo-sacral trunk.
3. obturator nerve.
4. external iliac artery.
5. psoas major muscle.
6. iliohypogastric nerve.
7. ilio-inguinal nerve.
8. lateral cutaneous nerve of thigh.
9. femoral nerve.

* The iliohypogastric and ilio-inguinal nerves descend above the iliac crest, while the lateral cutaneous nerve of thigh crosses the iliac crest and the iliacus muscle.

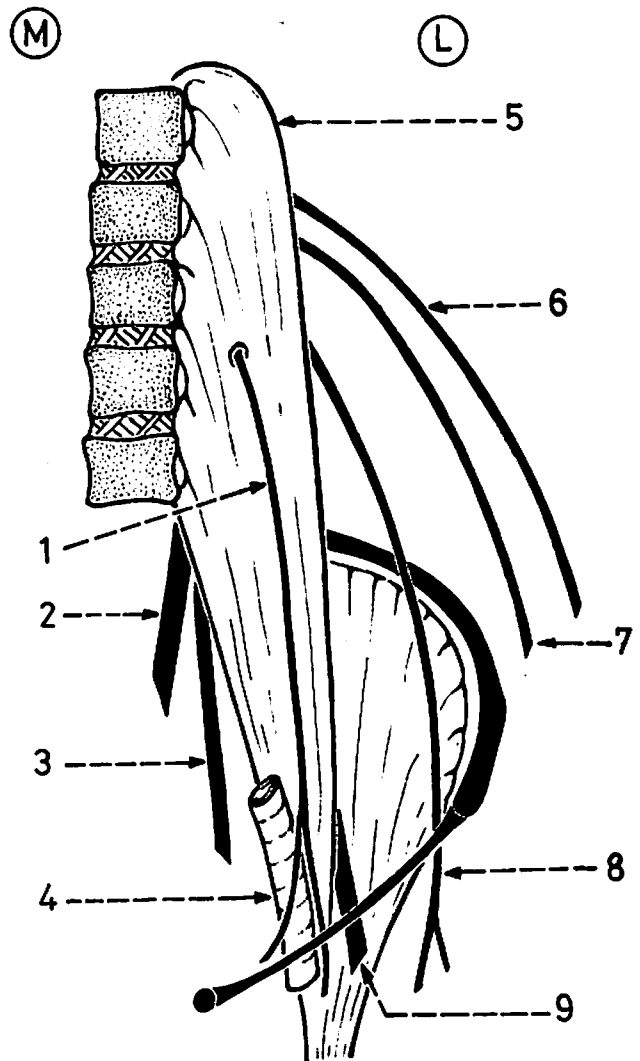


Fig.(339): LUMBAR PART OF SYMPATHETIC TRUNK

It lies one on each side of the vertebral column along the medial margin of psoas major. It begins behind the medial arcuate ligament and enters the pelvis behind the common iliac artery. On the right side it lies behind the I.V.C., while on the left side it lies just to the left of the aorta.

1. right crus of diaphragm.
2. medial arcuate ligament.
3. right sympathetic trunk.
4. inferior vena cava.
5. psoas major.
6. left crus of diaphragm.
7. medial arcuate ligament.
8. left sympathetic trunk.
9. abdominal aorta.

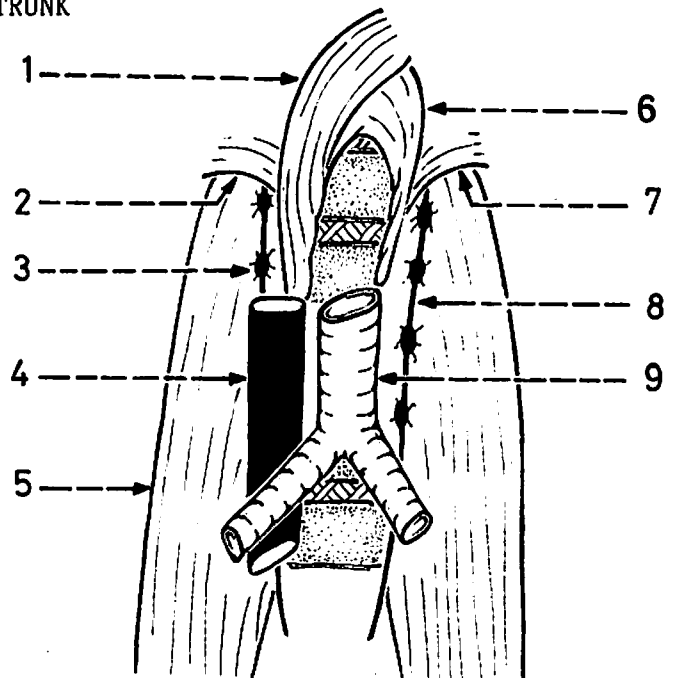


Fig.(340): CONNECTIONS OF LUMBAR SYMPATHETIC TRUNK

The lumbar sympathetic trunk consists of fibres and 4 ganglia. Grey rami communicantes emerge from the 4 lumbar ganglia to all lumbar spinal nerves, while white rami communicantes join the upper 2 ganglia only. 4 lumbar splanchnic nerves pass from the 4 ganglia as preganglionic fibres to the coeliac, aortic and superior hypogastric plexuses.

1. grey ramus communicans (postganglionic).
2. white rami communicantes (preganglionic to the upper 2 ganglia only).
3. coeliac plexus.
4. aortic plexus.
5. superior hypogastric plexus.
6. lumbar splanchnic nerve (the 4th).
7. 4th lumbar ganglion.

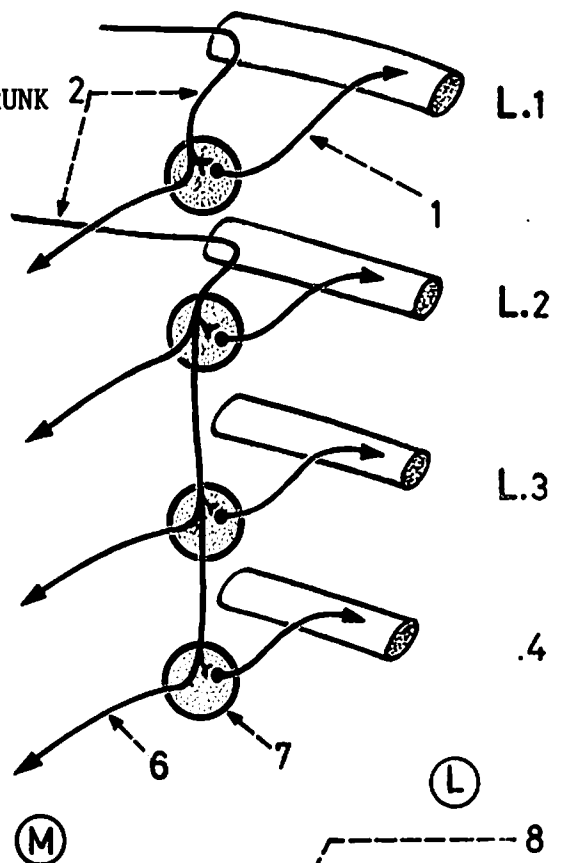


Fig.(341): AUTONOMIC ABDOMINAL PLEXUSES

Autonomic plexuses are aggregations of autonomic nerves and ganglia. The largest plexus in the abdomen is the coeliac plexus from which 2ry plexuses pass to surround the aorta and its branches.

1. right suprarenal gland.
2. coeliac plexus.
3. renal plexus.
4. aortic plexus.
5. pelvic splanchnic nerve (parasympathetic, S.2,3,4).
6. fibres from sympathetic trunk to superior hypogastric plexus.
7. hypogastric plexus.
8. left vagus nerve.
9. greater splanchnic nerve.
10. lesser splanchnic nerve.
11. left suprarenal gland.
12. coeliac ganglion.
13. superior mesenteric plexus.
14. inferior mesenteric plexus.

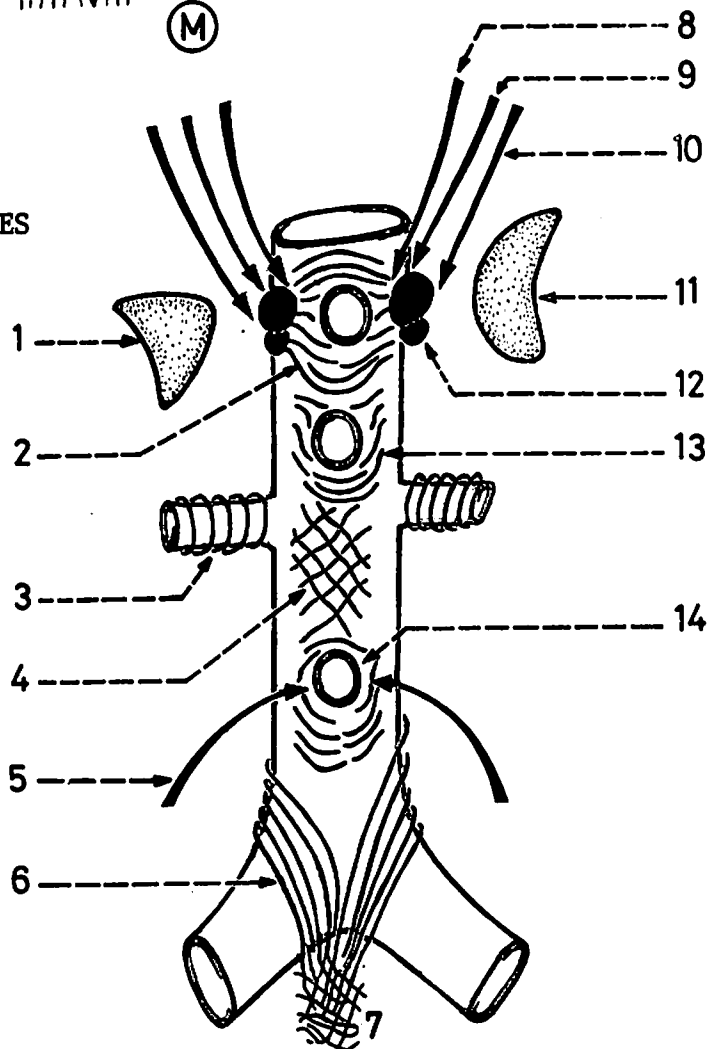
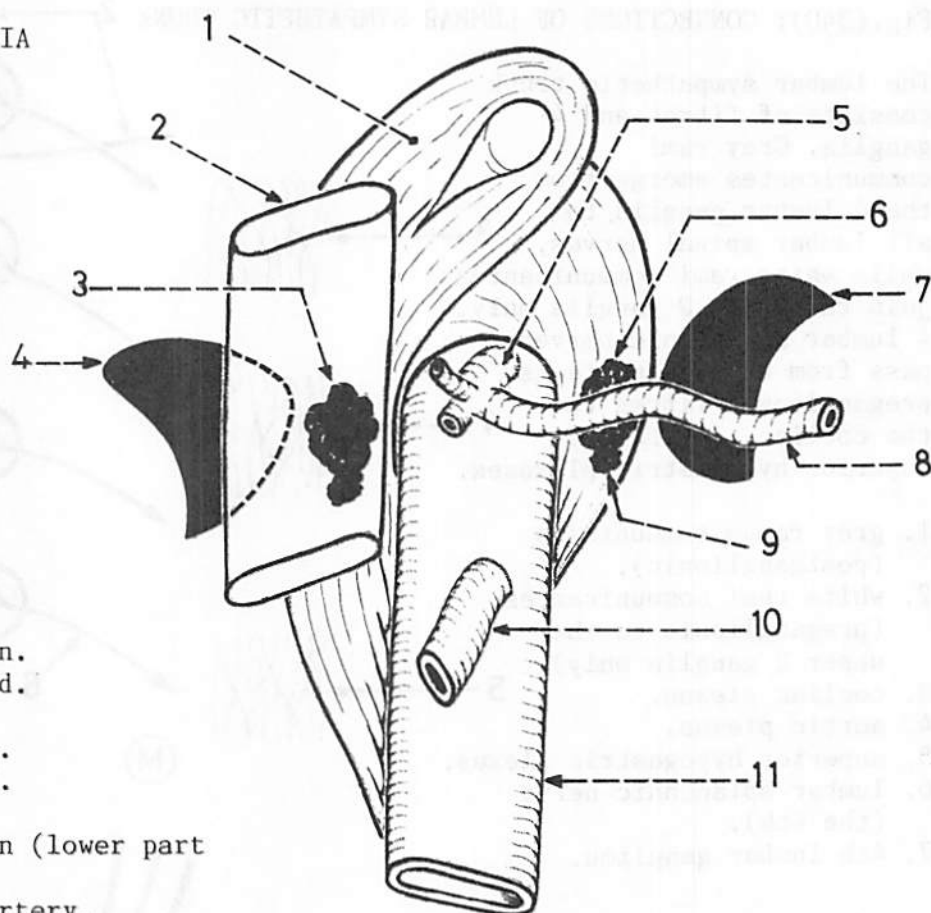


Fig.(342): COELIAC GANGLIA

These are 2 large ganglia placed one on each side of the coeliac trunk. The lower part of the ganglion is partially separated to form the aortico-renal ganglion. The right ganglion lies behind the I.V.C. while the left one lies behind the splenic vessels.

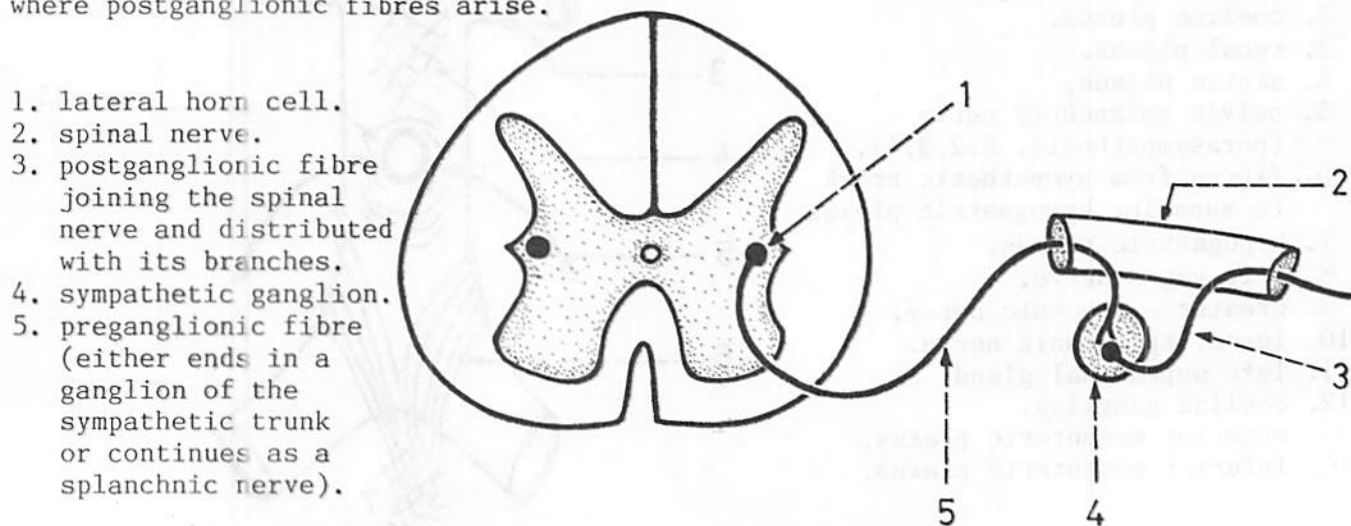


1. right crus of diaphragm.
2. inferior vena cava.
3. right coeliac ganglion.
4. right suprarenal gland.
5. coeliac trunk.
6. left coeliac ganglion.
7. left suprarenal gland.
8. splenic artery.
9. aortico-renal ganglion (lower part of coeliac ganglion).
10. superior mesenteric artery.
11. aorta.

* Note the close relation of the coeliac ganglion to the medial border of the suprarenal gland.

Fig.(343): COURSE OF SYMPATHETIC FIBRES

Sympathetic fibres arise from the lateral horn cells of spinal cord (T.1 to L.2) and leave the cord as preganglionic fibres. They relay in sympathetic ganglia where postganglionic fibres arise.

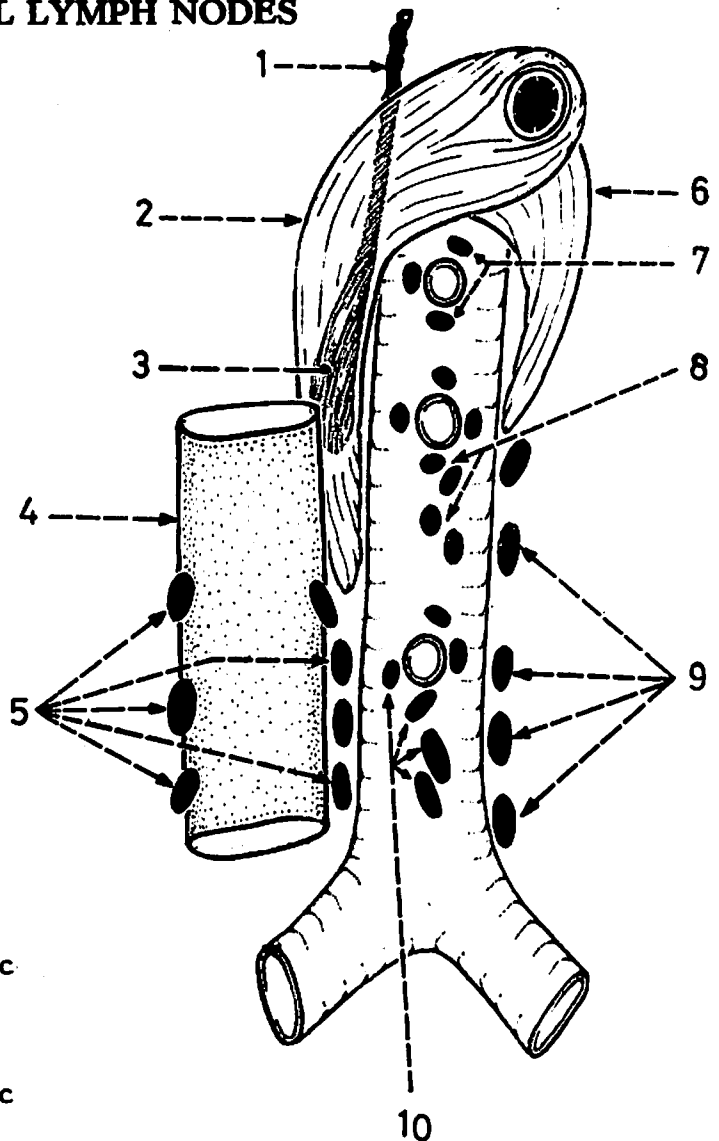


1. lateral horn cell.
2. spinal nerve.
3. postganglionic fibre joining the spinal nerve and distributed with its branches.
4. sympathetic ganglion.
5. preganglionic fibre (either ends in a ganglion of the sympathetic trunk or continues as a splanchnic nerve).

ABDOMINAL LYMPH NODES

Fig.(344): GROUPS OF ABDOMINAL LYMPH NODES

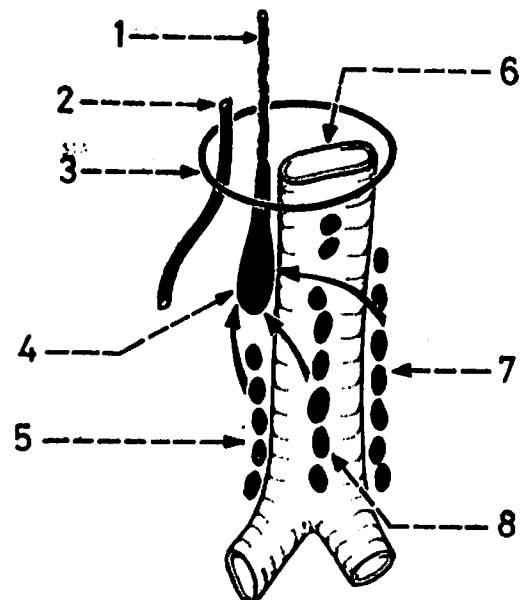
The abdominal lymph nodes are placed along the aorta and its 3 ventral branches. They are grouped into: pre-aortic nodes (in front of the aorta and are arranged into coeliac, superior mesenteric and inferior mesenteric groups), lateral aortic nodes (arranged as 2 chains one on each side of the aorta) and retro-aortic nodes (behind the aorta).



1. thoracic duct.
2. right crus of diaphragm.
3. cisterna chyli (behind the right crus).
4. inferior vena cava.
5. lateral aortic nodes surrounding the I.V.C.
6. left crus of diaphragm.
7. coeliac nodes around the coeliac trunk.
8. superior mesenteric nodes around the superior mesenteric artery.
9. lateral aortic nodes.
10. inferior mesenteric nodes around the inferior mesenteric artery.

Fig.(345): CISTERNA CHYLI

It is a dilated sac which lies under cover of the right crus of the diaphragm. It receives right and left lumbar lymph trunks from the lateral aortic nodes and one intestinal lymph trunk from the pre-aortic nodes.



1. thoracic duct (arises from the cisterna chyli).
2. azygos vein.
3. aortic opening of diaphragm.
4. cisterna chyli.
5. right lateral aortic nodes.
6. aorta.
7. left lateral aortic nodes.
8. pre-aortic nodes.

**PELVIS
&
PERINEUM**

BONY PELVIS

Fig.(346): BONES OF THE PELVIS

The pelvis is composed of the 2 hip bones (in front and laterally), and the sacrum and coccyx (behind). The 2 hip bones articulate together anteriorly at the symphysis pubis and articulate posteriorly with the sides of the sacrum at the sacro-iliac joints.

1. sacrum.
2. sacro-iliac joint.
3. hip bone.
4. pelvic cavity.
5. symphysis pubis.

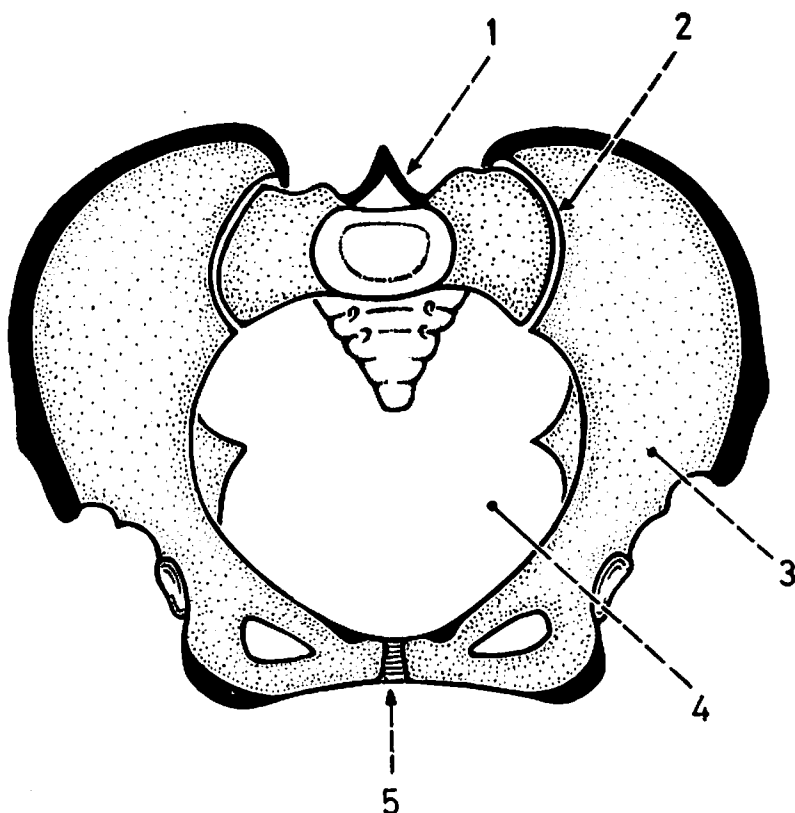


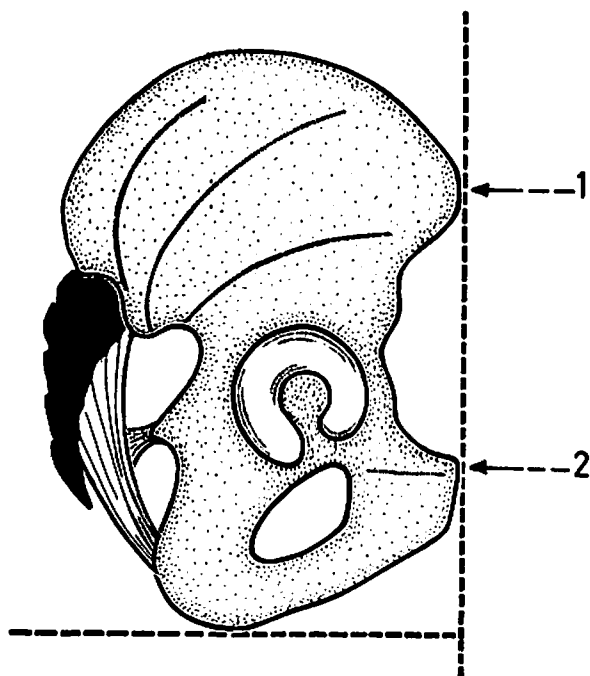
Fig.(347): ORIENTATION OF THE BONY PELVIS

To put the bony pelvis in the anatomical position (erect posture), the anterior superior iliac spines and the pubic tubercles should lie on the same vertical plane.

In this position the surfaces of the pelvis are directed as follows:

- * The pelvic surface of the symphysis pubis faces upwards and backwards.
- * The concavity of the sacrum faces downwards and forwards.

1. anterior superior iliac spine.
2. pubic tubercle.



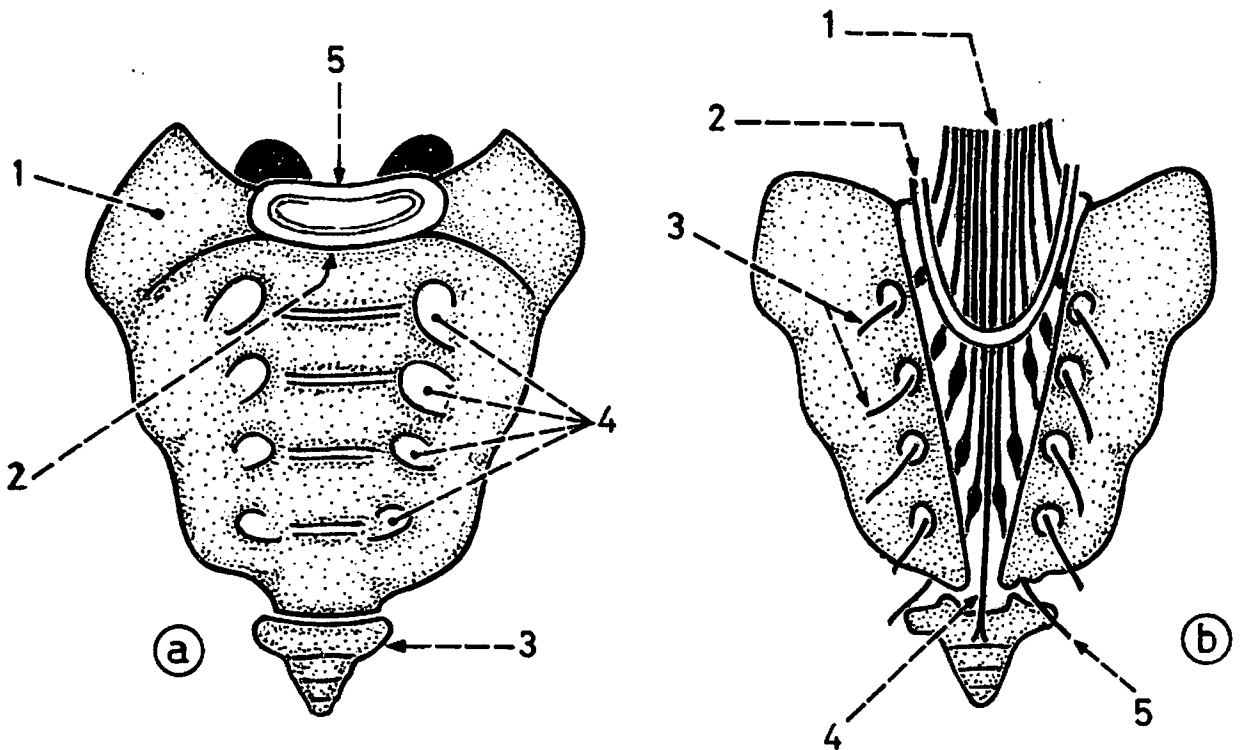


Fig.(348): SACRUM AND COCCYX

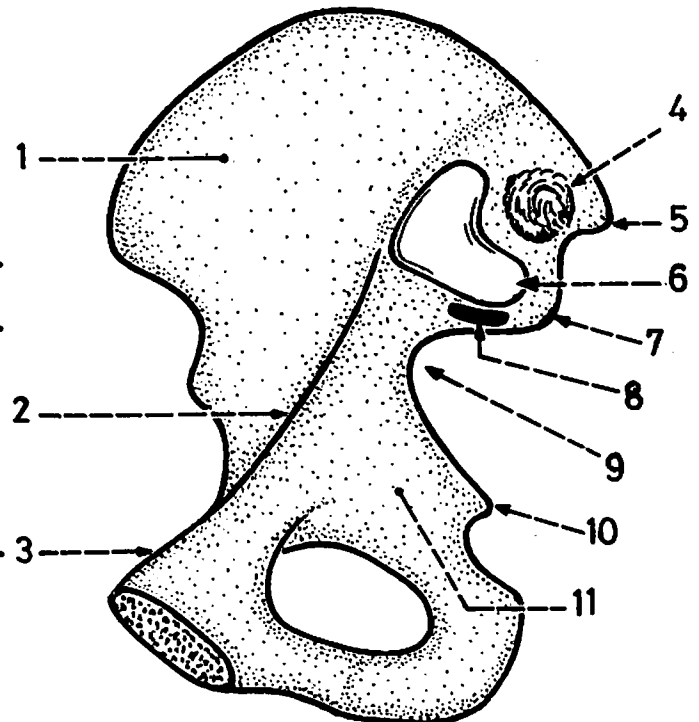
- (a) Ventral surface: 1. ala of sacrum; 2. promontory of sacrum; 3. coccyx; 4. ventral sacral foramina; 5. base of sacrum.
- (b) Contents of sacral canal: 1. cauda equina; 2. spinal meninges (dura and arachnoid); 3. dorsal branches of sacral nerves; 4. filum terminale; 5. 5th sacral nerve.

* The dura and arachnoid mater end opposite the 2nd sacral vertebra.

Fig.(349): INNER SURFACE OF HIP BONE

1. iliac fossa.
2. arcuate line.
3. pecten pubis.
4. iliac tuberosity.
5. posterior superior iliac spine.
6. auricular surface.
7. posterior inferior iliac spine.
8. pre-auricular sulcus.
9. greater sciatic notch.
10. ischial spine.
11. sacropelvic surface.

* The arcuate line forms part of the inlet of the lesser pelvis.



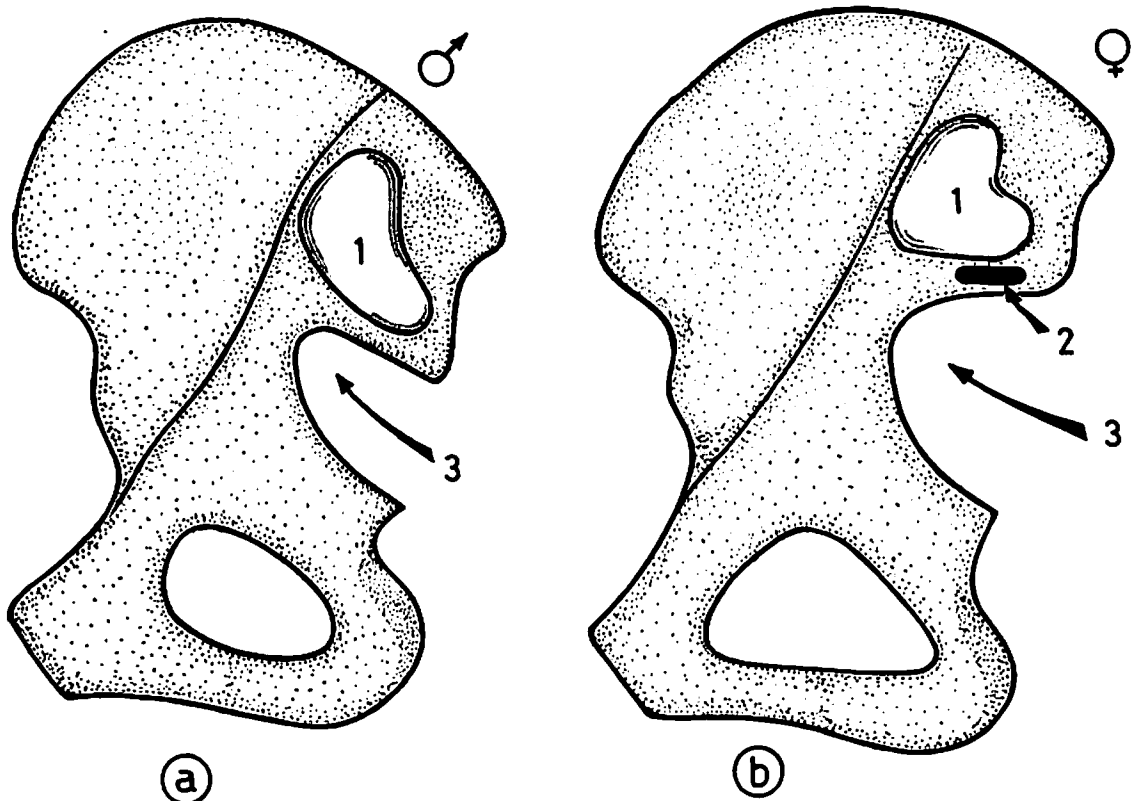


Fig.(350): MAIN SEX FEATURES OF HIP BONE

(a) Male hip bone.

(b) Female hip bone.

1. the auricular surface is longer in the male than in the female.
2. the pre-auricular sulcus is only found in the female.
3. the greater sciatic notch is deep and narrow in the male, but shallow and wide in the female.

Fig.(351): SEX FEATURES OF PUBIC BONES

(a) In the male.

(b) In the female.

1. the distance between the symphysis pubis and anterior margin of acetabulum is longer than the transverse diameter of the acetabulum in the female, but are equal in the male.
2. the pubic arch forms an acute angle in the male but a right angle in the female.

* These features of pubic bones in the female contribute to the width of the pelvic cavity.

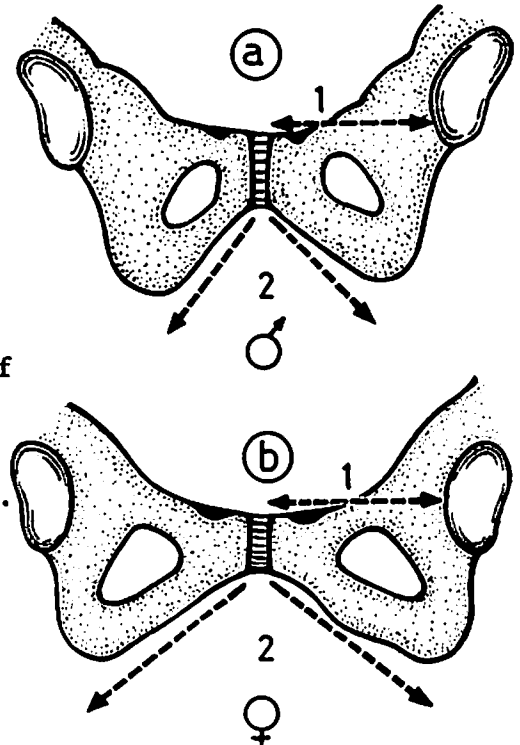


Fig.(352): DIVISIONS OF THE PELVIS

The pelvis is divided into greater (false) pelvis and lesser (true) pelvis by an oblique plane which forms the pelvic inlet. The greater pelvis lies above the pelvic inlet, while the lesser pelvis lies below and behind it.

1. iliac fossa forming the side of the greater pelvis.
2. promontory of sacrum.
3. arcuate line.
4. pecten pubis.
5. pubic crest.
6. side wall of the lesser pelvis.

* The arcuate line, pecten pubis and pubic crest form one continuous line called linea terminalis. This linea terminalis forms the anterior and lateral parts of the boundary of the pelvic inlet.

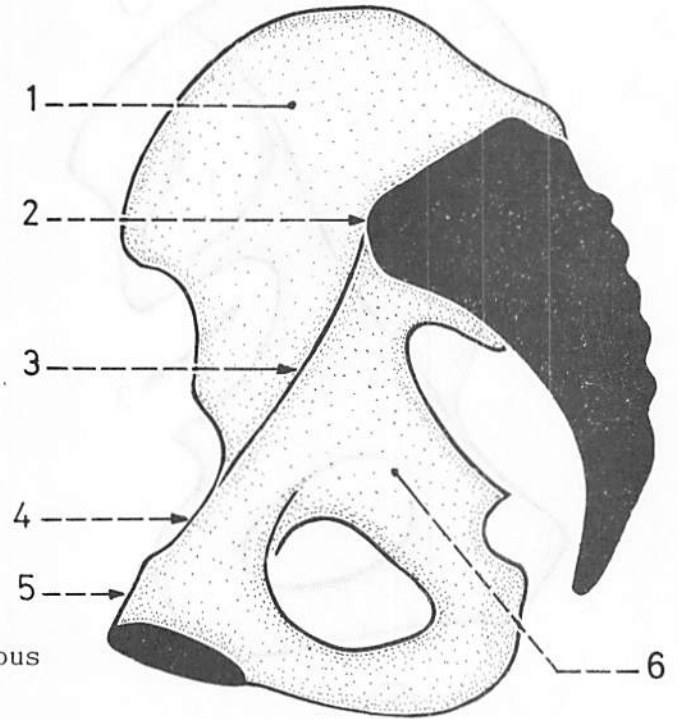


Fig.(353): INLET AND OUTLET OF THE LESSER PELVIS

The bony boundaries of the pelvic inlet constitute the brim of the pelvis; they consist of the promontory of sacrum (behind) and the linea terminalis (on each side and in front). The pelvic outlet corresponds to the plane extending from the tip of the coccyx (behind) to the under surface of the symphysis pubis (in front).

1. linea terminalis forming the anterior and lateral boundary of the pelvic inlet.
2. pelvic cavity (between the inlet and outlet).
3. plane of pelvic outlet.

* The pelvic brim is the bony edge which surrounds (bounds) the pelvic inlet.

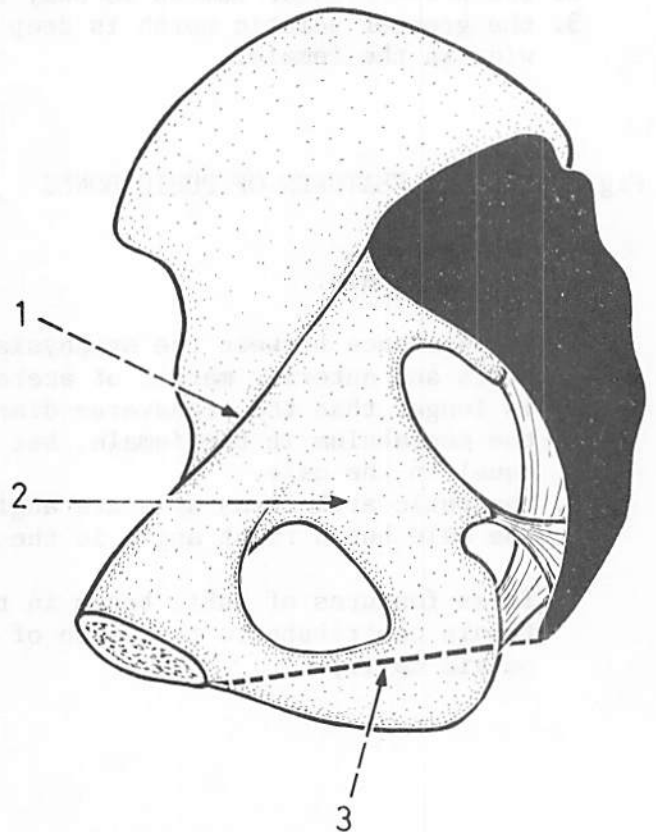


Fig.(354): AXES OF THE PELVIC INLET AND PELVIC OUTLET

The axis of the pelvic inlet passes downwards and backwards at right angle to the plane of the inlet. The axis of the outlet passes mainly downwards and slightly backwards at right angle to the plane of the outlet.

- (a) axis of pelvic inlet.
- (b) axis of pelvic outlet.
- (c) pelvic cavity.

- 1. symphysis pubis.
- 2. tip of coccyx.

* Note that the pelvic cavity is a short curved canal extending between the inlet and outlet. This canal is much deeper behind than in front and its axis is a curved line which runs parallel with the curve of the sacrum and coccyx.

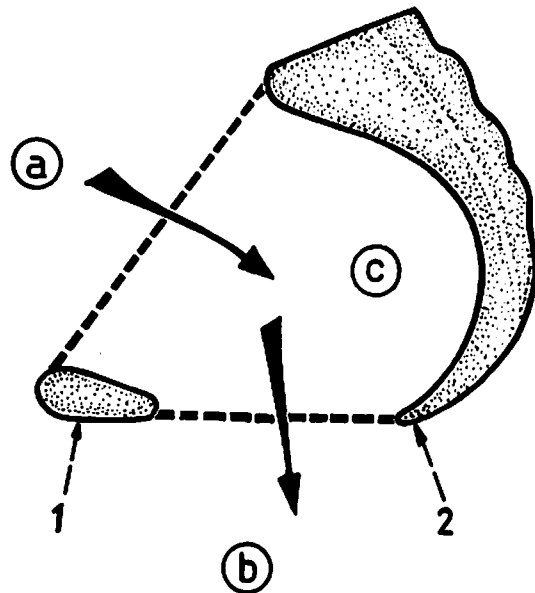


Fig.(355): INCLINATION OF THE PELVIS

In the erect posture the pelvis lies obliquely in relation to the trunk. The plane of the inlet is more oblique than the plane of the outlet. The plane of the inlet forms an angle of 50° with the horizontal plane, while the plane of the outlet forms only 15° with the horizontal plane.

- (a) The angle between the plane of the inlet and the horizontal plane (50°).
- (b) The angle between the plane of the outlet and the horizontal plane (15°).

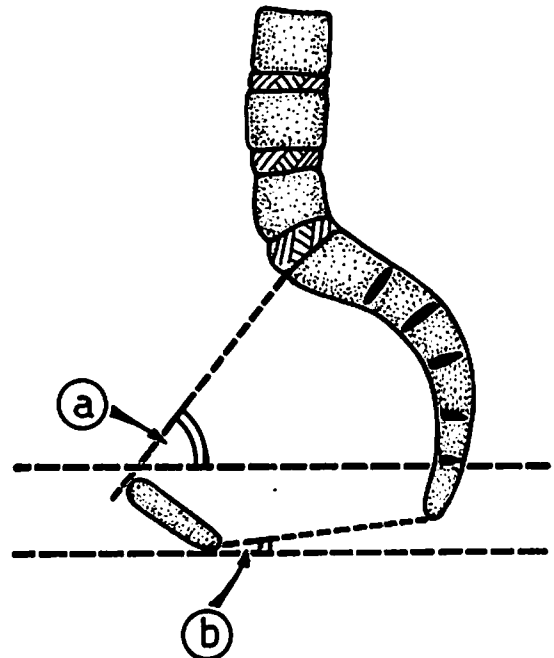
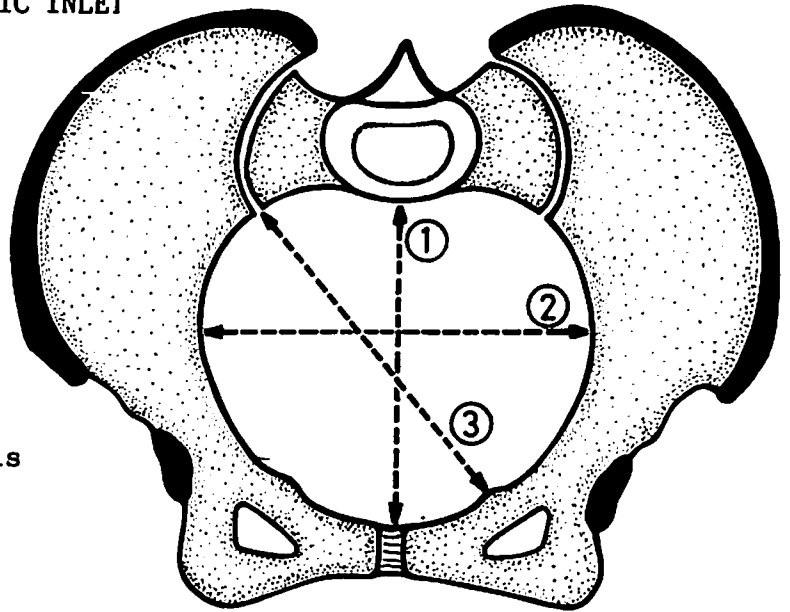


Fig.(356): DIAMETERS OF THE PELVIC INLET

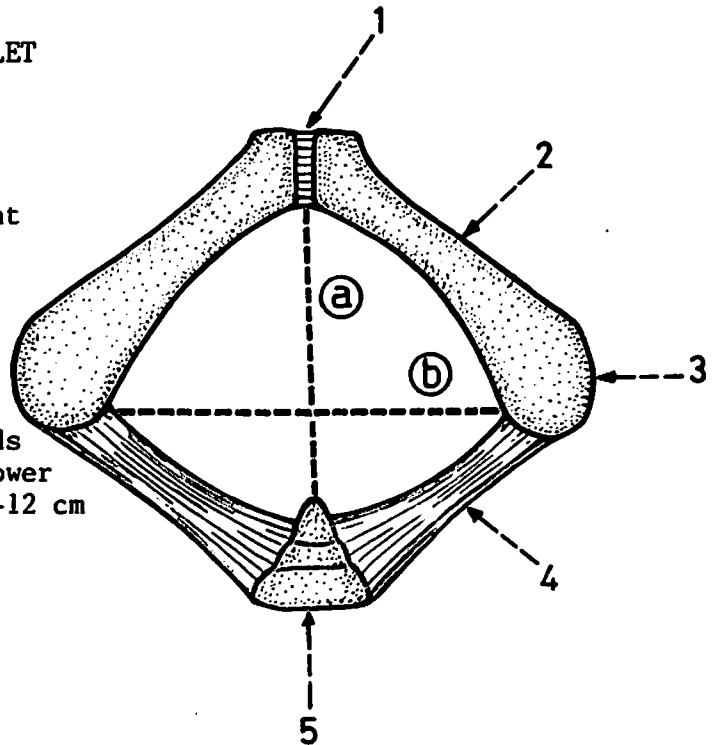
The boundaries of the bony inlet (pelvic brim) include the promontory of sacrum (behind) and the linea terminalis (one on each side and in front). The inlet has 3 diameters: antero-posterior, transverse and oblique.



1. antero-posterior diameter (true conjugate): extends from symphysis pubis in front, to the sacral promontory behind (11 cm in female).
2. transverse diameter: extends from the middle of the pelvic brim on one side to the same point on the opposite side (13 cm in female).
3. oblique diameter: extends from the iliopubic (iliopectineal) eminence on one side to the sacro-iliac joint on the opposite side (12 cm in female).

Fig.(357): DIAMETERS OF THE PELVIC OUTLET

The pelvic outlet is rhomboidal in outline and is bounded by the apex of coccyx (behind), ischial tuberosity and sacrotuberous ligament (on each side) and sides of pubic arch and inferior edge of symphysis pubis (in front). The pelvic outlet has 2 diameters: antero-posterior and transverse.



- (a) Antero-posterior diameter: extends from the apex of coccyx to the lower edge of symphysis pubis (about 9-12 cm in female).
 - (b) Transverse diameter: extends transversely between the tips of ischial tuberosities of both sides (11 cm in female).
1. symphysis pubis.
 2. side of pubic arch.
 3. ischial tuberosity.
 4. sacrotuberous ligament.
 5. coccyx.

TYPES OF FEMALE PELVIS

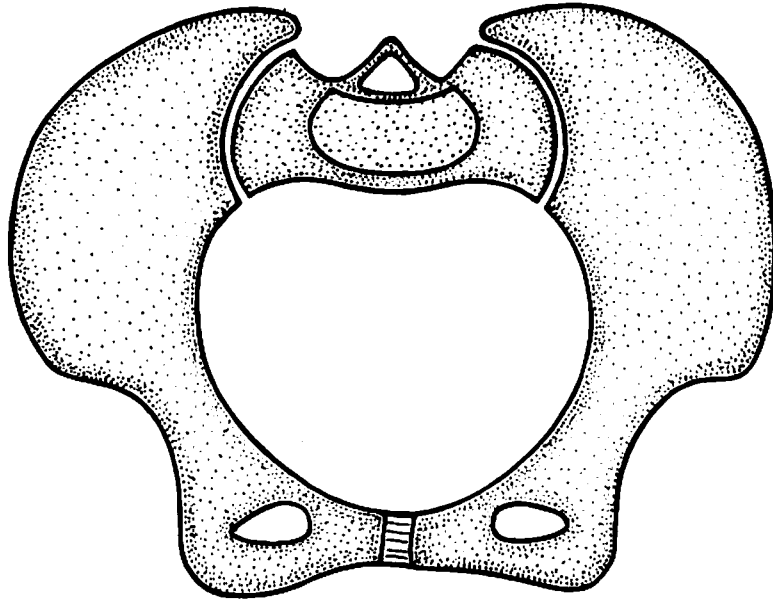


Fig.(358): GYNAECOID PELVIS

It is a typical female pelvis having normal diameters, and a wide pubic arch.

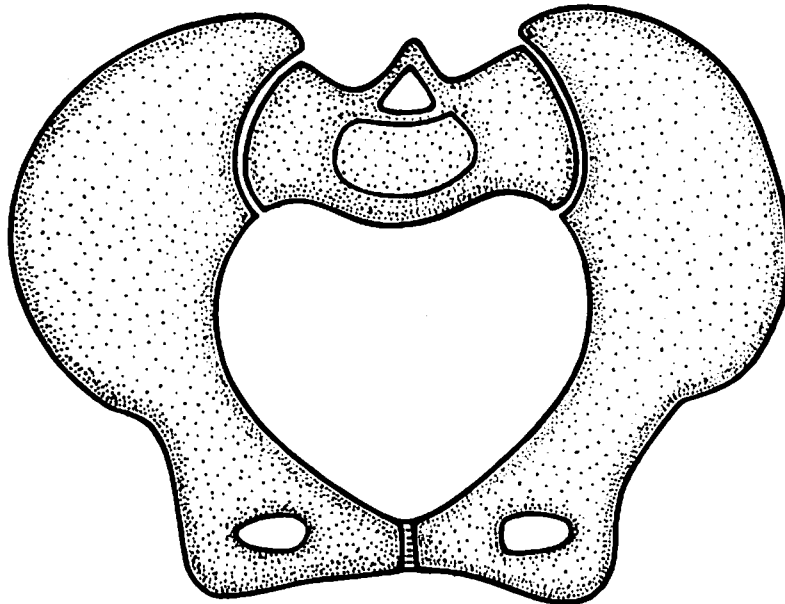


Fig.(359): ANDROID PELVIS

It is a female pelvis which has a heart-shaped inlet (male-like), and a narrow pubic arch.

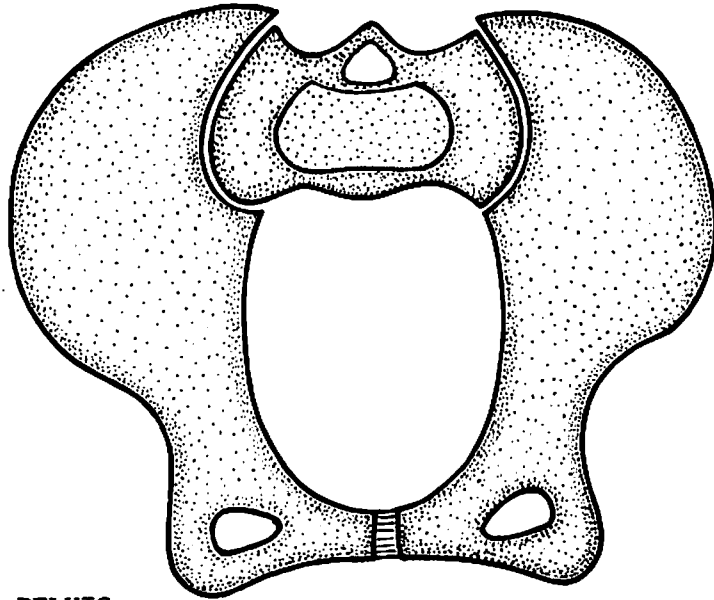


Fig.(360): ANTHROPOID PELVIS

It is a female pelvis which is contracted from side to side (ape-like). It has an oval inlet with its antero-posterior diameter longer than its transverse diameter.

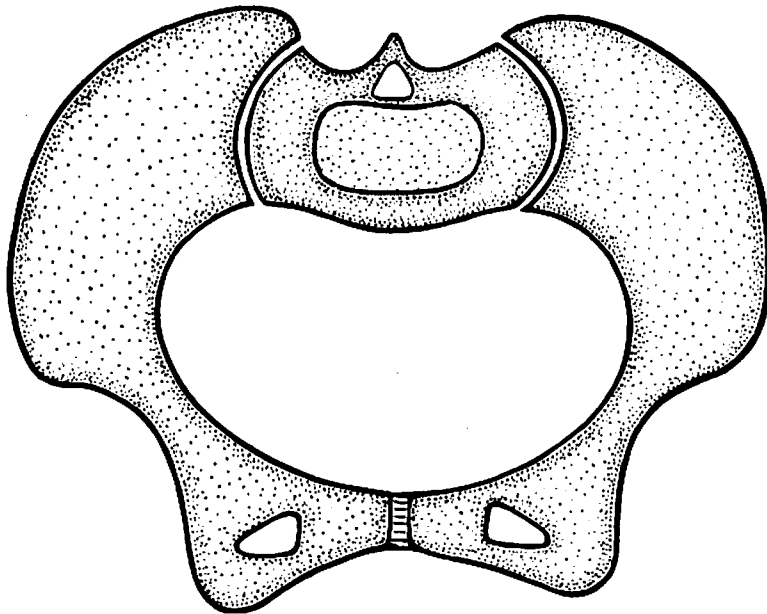


Fig.(361): PLATYPELLOID PELVIS

It is a female pelvis which is contracted from before backwards. It has an oval inlet with its transverse diameter much longer than the antero-posterior (longer than normal).

JOINTS OF THE PELVIS

Fig.(362): SACRO-ILIAC JOINT

It is a synovial joint of the plane variety, between the auricular surfaces of the sacrum and ilium. It is supported by 3 ligaments: ventral, dorsal and interosseous sacro-iliac ligaments.

1. dorsal sacro-iliac ligament (lies dorsal to the joint, close to the iliac crest).
2. interosseous sacro-iliac ligament (the strongest ligament and is attached to the iliac tuberosity immediately dorsal to the joint).
3. auricular surface of the ilium.
4. ventral sacro-iliac ligament (lies just ventral and below the joint).

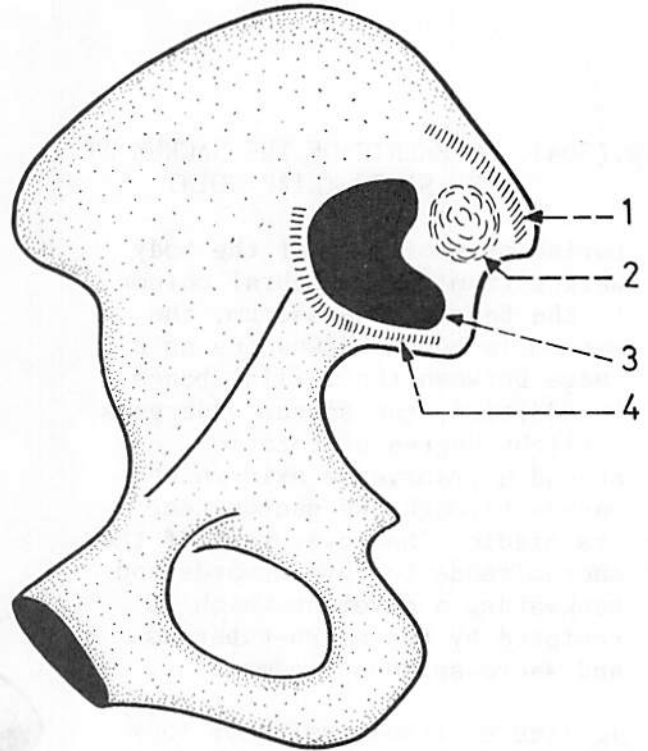


Fig.(363): SACRO-TUBEROUS AND SACRO-SPINOUS LIGAMENTS

These 2 ligaments extend between the ischium and the lateral part of the sacrum. They help in the stability of the lower part of the sacrum during transmission of the body weight from the vertebral column to the base of the sacrum.

1. greater sciatic foramen.
2. sacro-spinous ligament (from the ischial spine to the lower part of the lateral margin of the sacrum and adjoining part of coccyx).
3. sacro-tuberous ligament (from the ischial tuberosity to the back of the sacrum).
4. lesser sciatic foramen.

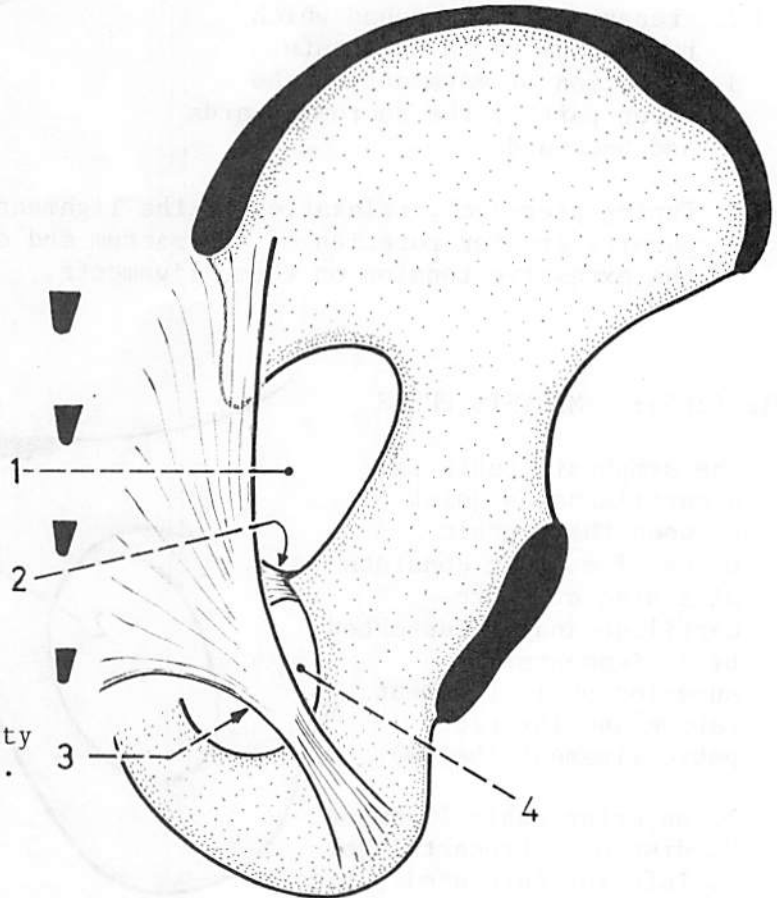
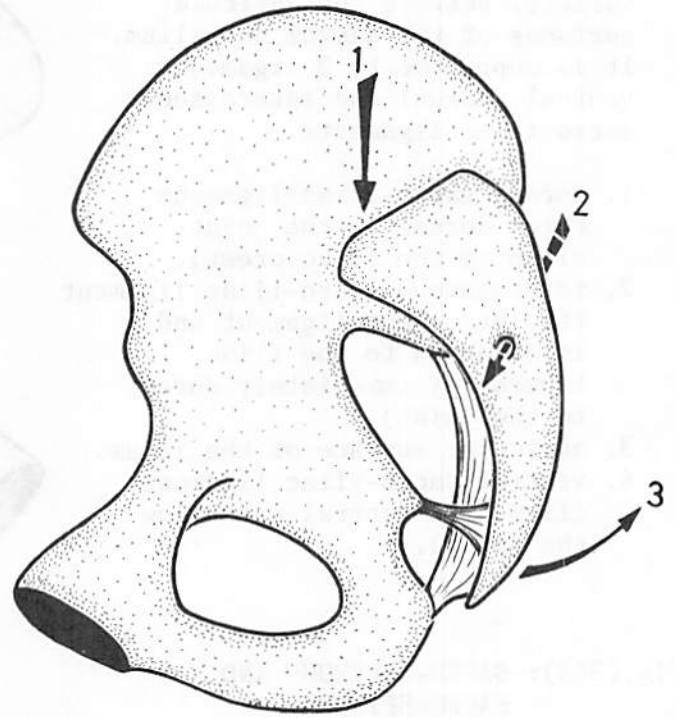


Fig.(364): MOVEMENTS OF THE SACRUM AT THE SACRO-ILIAC JOINT

During transmission of the body weight from the vertebral column to the base of the sacrum, the sacrum is pushed downwards as a wedge between the 2 iliac bones. In addition, the sacrum undergoes a slight degree of rotation around a transverse axis which passes through the sacrum near its middle. The lower part of the sacrum tends to move upwards and backwards, a movement which is resisted by the sacro-tuberous and sacro-spinous ligament.

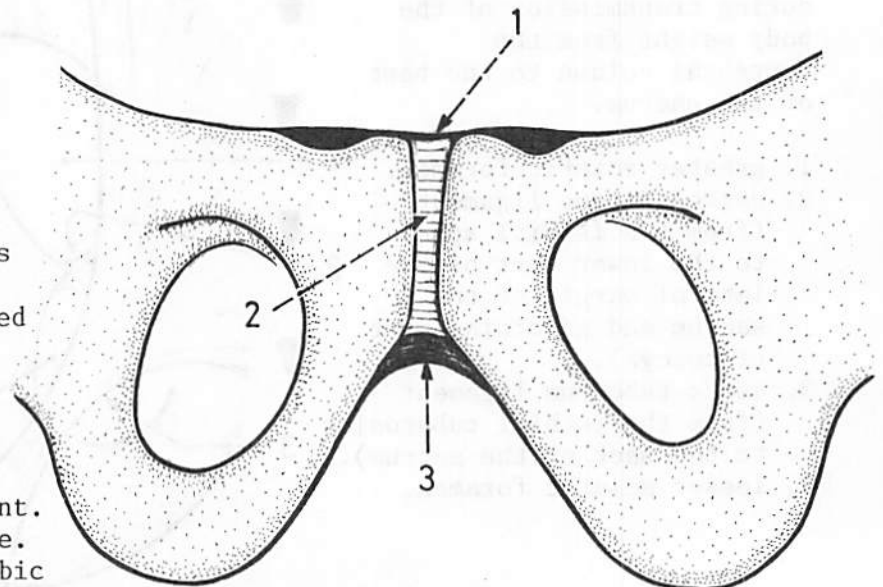


1. line of transmission of body weight pushing the promontory downwards and forwards.
2. transverse axis around which the sacrum tends to rotate.
3. direction of movement of the lower part of the sacrum upwards and backwards.

* During pregnancy, relaxation of the ligaments of the sacro-iliac joint permits greater rotation of the sacrum and consequently pain results from the excessive tension on these ligaments.

Fig.(365): SYMPHYSIS PUBIS

The symphysis pubis is a cartilaginous joint between the 2 pubic bones. The joint consists of a disc of fibrocartilage and is supported by 2 ligaments: superior pubic ligament (above) and inferior pubic ligament (below).



1. superior pubic ligament.
2. disc of fibrocartilage.
3. inferior (arcuate) pubic ligament (thick with an arched lower border).

PELVIC FASCIA AND PELVIC PERITONEUM

PELVIC FASCIA

Fig.(366): PARTS OF PELVIC
FASCIA (coronal section)

The pelvic fascia comprises both the parietal pelvic fascia which covers the pelvic muscles, and the visceral pelvic fascia which ensheathes the pelvic viscera.

1. visceral peritoneum.
2. visceral pelvic fascia.
3. parietal peritoneum.
4. parietal pelvic fascia.
5. ischium in coronal section.
6. floor of the pelvis.
7. pelvic viscus.

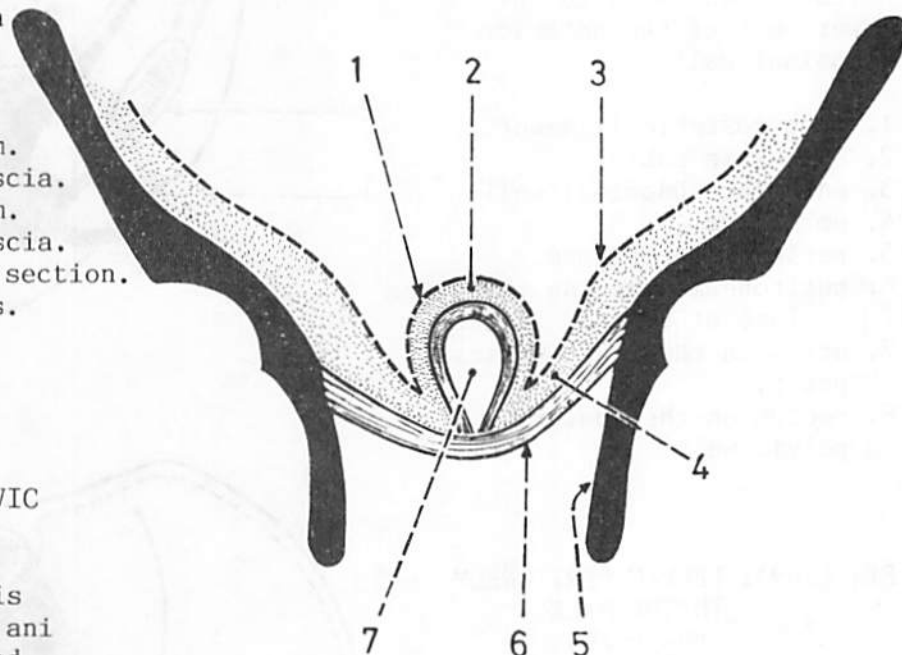
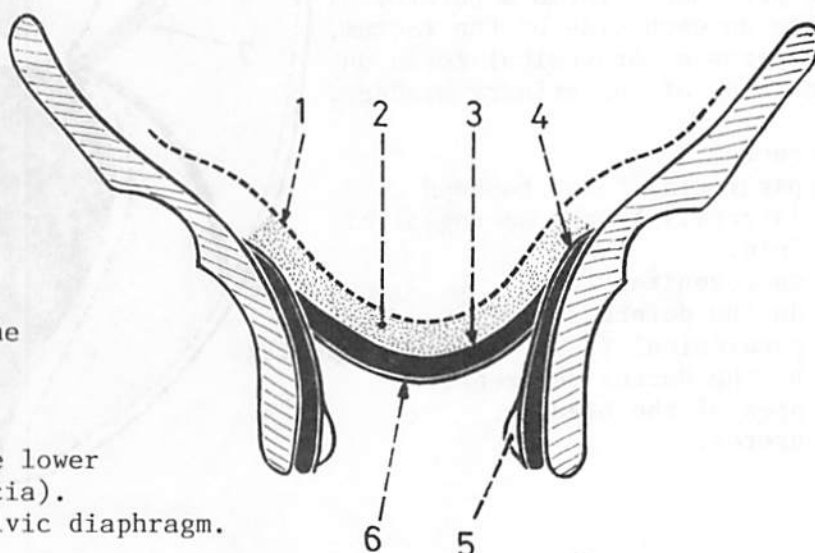


Fig.(367): FASCIA OF PELVIC
DIAPHRAGM

The pelvic diaphragm is formed by the levator ani muscle which is covered on its upper surface by the superior fascia of pelvic diaphragm and on its lower surface by the inferior fascia of pelvic diaphragm.

1. pelvic peritoneum.
2. superior fascia of pelvic diaphragm.
3. levator ani forming the pelvic diaphragm.
4. obturator internus and its fascia.
5. pudendal canal (in the lower part of obturator fascia).
6. inferior fascia of pelvic diaphragm.



PELVIC PERITONEUM

Fig.(368): PELVIC PERITONEUM
IN THE MALE
(side view)

The peritoneum lines the posterior wall of the pelvis where it covers the upper 2/3 of the rectum. It is then reflected forwards on to the upper surface of the urinary bladder forming the recto-vesical pouch. From the bladder the peritoneum extends upwards on to the lower part of the anterior abdominal wall.

1. puboprostatic ligament.
2. symphysis pubis.
3. anterior abdominal wall.
4. umbilicus.
5. parietal peritoneum.
6. peritoneum covering the upper surface of urinary bladder.
7. arrow in the recto-vesical pouch.
8. rectum on the posterior pelvic wall

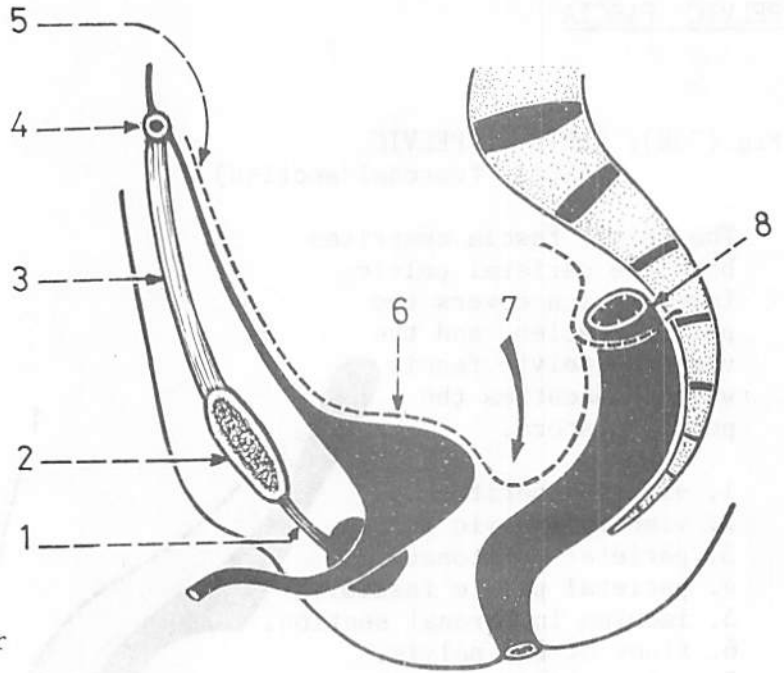


Fig.(369): PELVIC PERITONEUM
IN THE MALE
(top view)

The peritoneum forms a pararectal fossa on each side of the rectum, and forms a paravesical fossa on each side of the urinary bladder.

1. rectum.
2. pararectal fossa bounded laterally by the sacrogenital fold.
3. sacrogenital fold.
4. ductus deferens.
5. paravesical fossa bounded laterally by the ductus deferens.
6. apex of the bladder.
7. ureter.

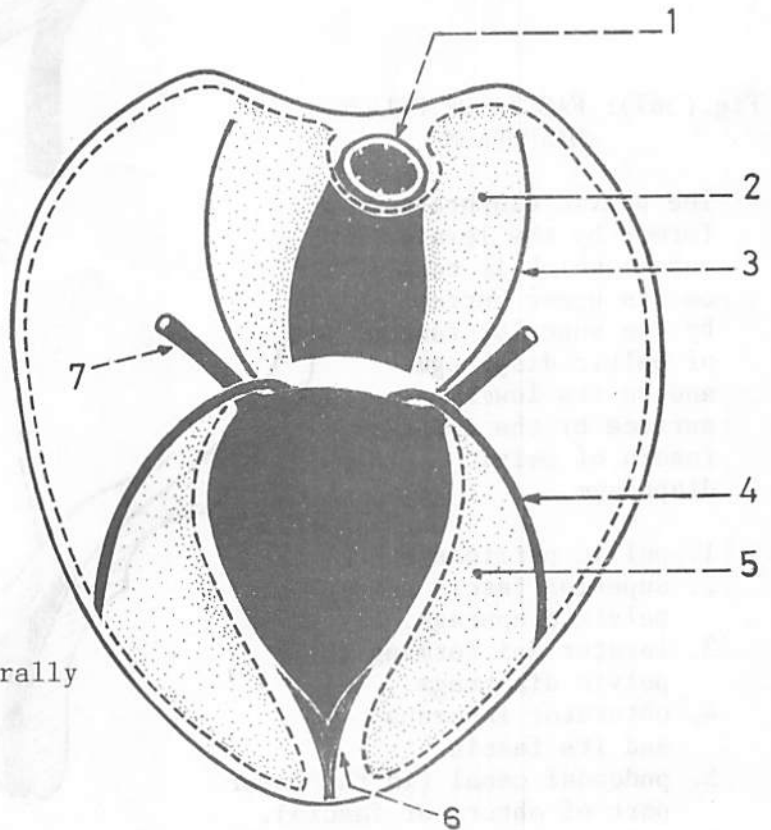
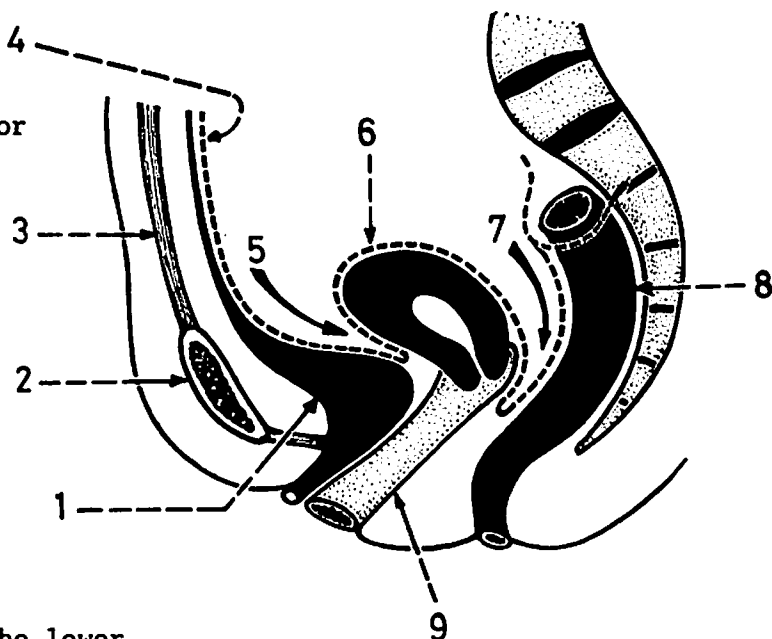


Fig.(370): PELVIC PERITONEUM
IN THE FEMALE
(side view)

The peritoneum lines the posterior wall of the pelvis where it covers the upper 2/3 of the rectum. It is then reflected on to the upper 1/4 of the back of the vagina, back of the cervix and body of uterus forming the recto-uterine pouch (of Douglas). The peritoneum then covers the fundus and anterior surface of the uterus down to its junction with the cervix where it is reflected on to the upper surface of the bladder forming the vesico-uterine pouch. From the bladder the peritoneum continues on to the lower part of the anterior abdominal wall.



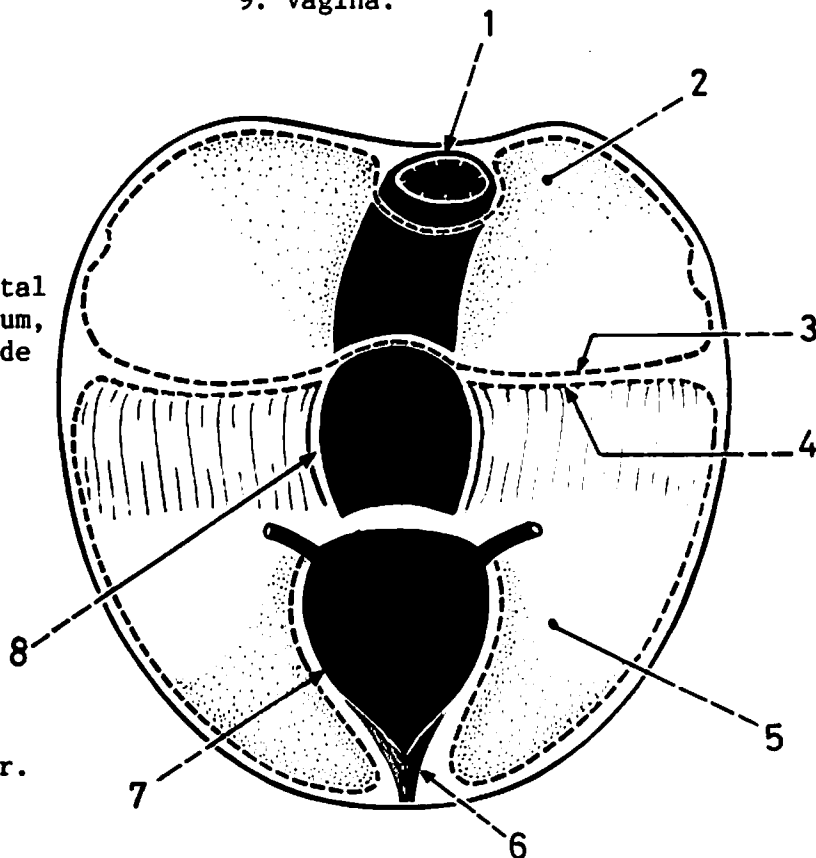
1. urinary bladder.
2. symphysis pubis.
3. anterior abdominal wall.
4. parietal peritoneum.
5. vesico-uterine pouch.

6. peritoneum covering the uterus.
7. recto-uterine pouch.
8. rectum on posterior pelvic wall.
9. vagina.

Fig.(371): PELVIC PERITONEUM
IN THE FEMALE
(top view)

The peritoneum forms a pararectal fossa on each side of the rectum, a paravesical fossa on each side of the bladder and the broad ligament on each side of the uterus.

1. rectum
2. pararectal fossa.
3. posterior layer of broad ligament.
4. anterior layer of broad ligament.
5. paravesical fossa.
6. apex of the bladder.
7. upper surface of the bladder.
8. uterus.



MUSCLES OF THE PELVIS

Fig.(372): ARRANGEMENT OF
MUSCLES OF THE PELVIS
(coronal section)

The muscles of the pelvis line its walls and form its floor.

1. iliacus (fills the iliac fossa above the pelvic brim).
2. psoas major (overlies the pelvic brim).
3. obturator internus (on the side wall of the lesser pelvis below the pelvic brim).
4. levator ani (forms the floor of the pelvis).
5. ischium.
6. ischiorectal fossa.
7. rectum and anal canal.

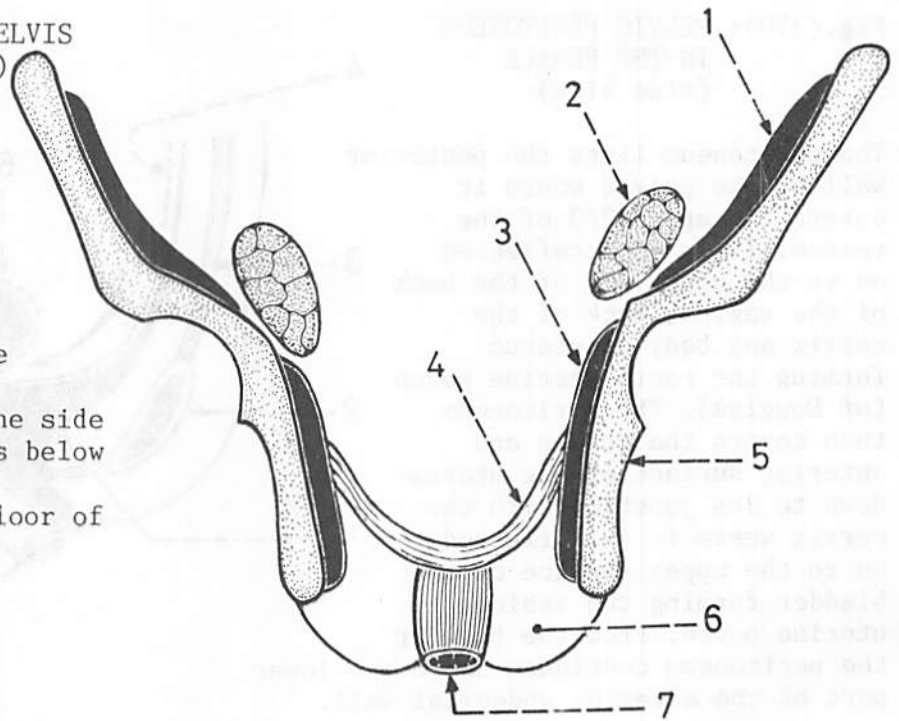


Fig.(373): POSITION OF OBTURATOR
INTERNUS

The fleshy fibres of the obturator internus line the side wall of the pelvis and its tendon of insertion enters the gluteal region through the lesser sciatic foramen. The muscle is covered by the obturator fascia which gives origin to the levator ani along a line called tendinous arch. The lower part of the fascia forms the pudendal canal.

1. part of obturator internus forming the side wall of pelvic cavity.
2. tendinous arch giving origin to the levator ani.
3. pudendal canal.
4. tendon of insertion of obturator internus.
5. part of obturator internus forming the side wall of the ischiorectal fossa.

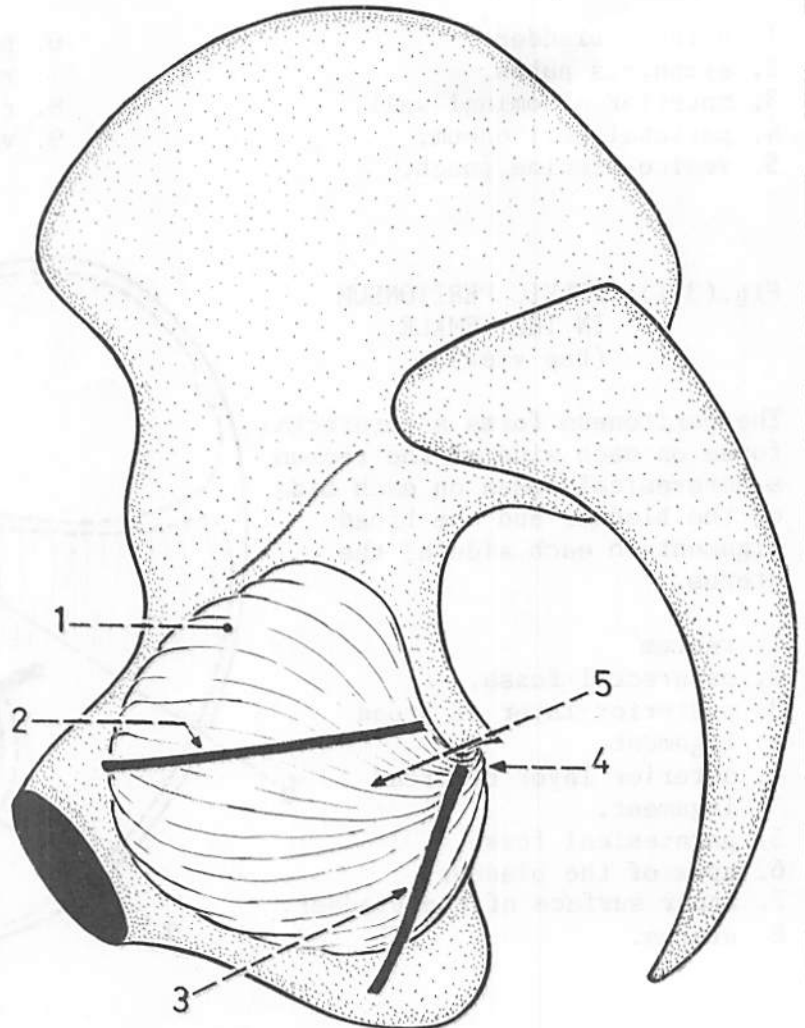


Fig.(374): PIRIFORMIS AND COCCYGEUS MUSCLES

These 2 muscles line the posterior wall of the pelvic cavity.

1. piriformis (arises by 3 fleshy digitations from the middle 3 sacral pieces and enters the gluteal region through the greater sciatic foramen).
2. coccygeus (a small triangular muscle situated between the piriformis above and the levator ani below; it completes the pelvic diaphragm from behind).

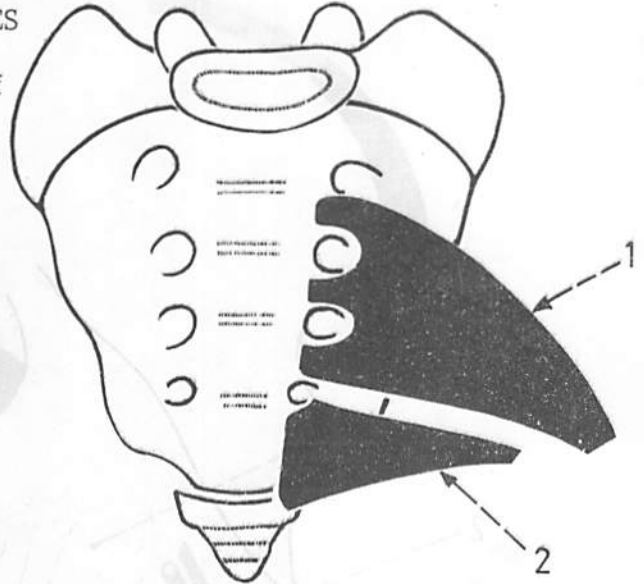
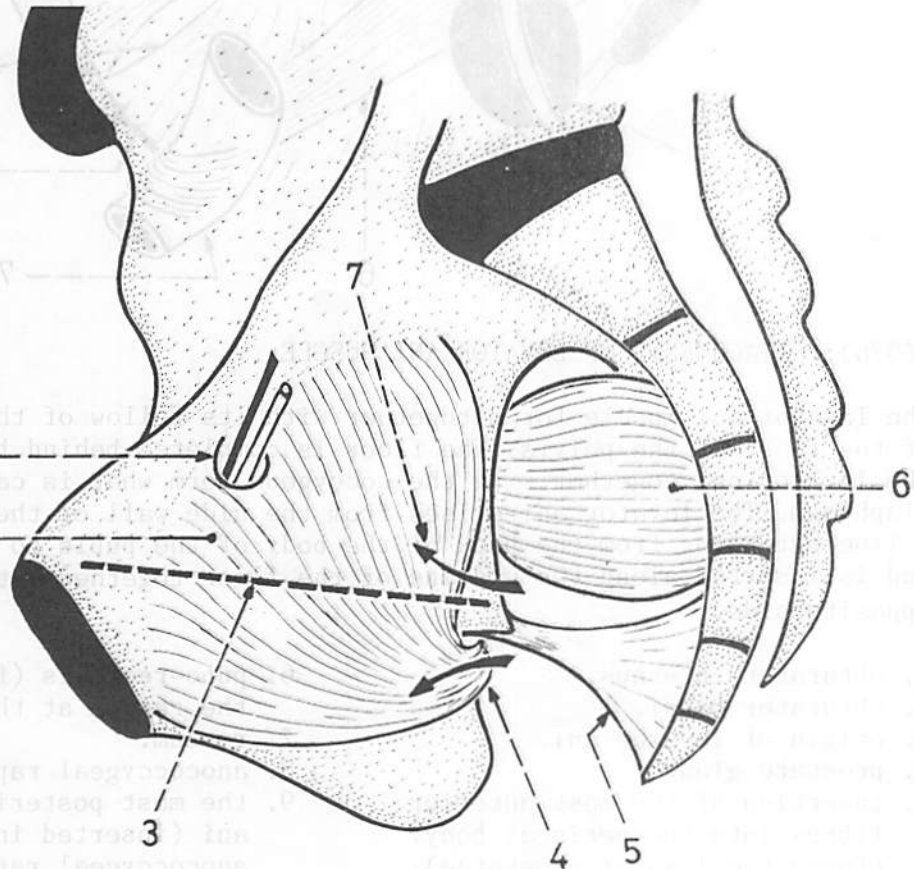


Fig.(375): PELVIC MUSCLES WHICH ENTER THE GLUTEAL REGION

These are the obturator internus and the piriformis. The tendon of obturator internus enters the gluteal region through the lesser sciatic foramen, while the tendon of piriformis enters the gluteal region through the greater sciatic foramen. The coccygeus muscle arises from the ischial spine just behind the origin of the levator ani from the ischial spine so that the lesser sciatic foramen leads to the ischio-rectal fossa (below the levator ani), while the greater sciatic foramen leads to the pelvic cavity (above the levator ani).

1. obturator canal.
2. obturator internus.
3. tendinous arch (origin of levator ani).
4. arrow to ischio-rectal fossa.
5. coccygeus.
6. piriformis (in the greater sciatic foramen).
7. arrow to pelvic cavity.



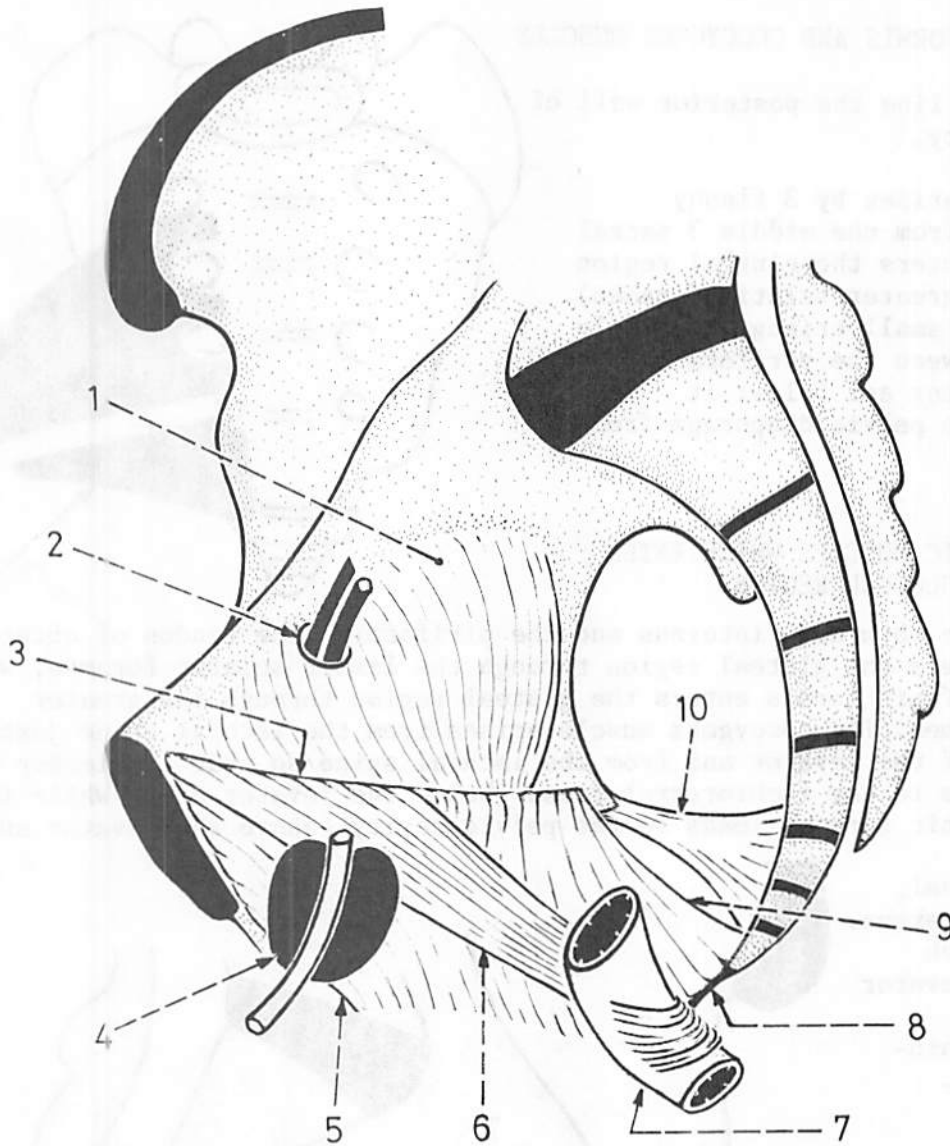


Fig.(376): ATTACHMENTS OF LEVATOR ANI MUSCLE

The levator ani muscle forms together with its fellow of the opposite side most of the floor of the pelvis. The floor is completed behind by the coccygeus. The levator ani together with the coccygeus form what is called the pelvic diaphragm. The levator ani arises from the side wall of the pelvic cavity along a line extending from the back of the body of the pubis to the ischial spine, and is inserted along the midline of the floor together with its fellow of the opposite side.

- | | |
|---|--|
| 1. obturator internus. | 6. pubo-rectalis (forms a sling behind the rectum at the ano-rectal junction). |
| 2. obturator canal. | 7. rectum. |
| 3. origin of levator ani. | 8. anococcygeal raphe. |
| 4. prostate gland. | 9. the most posterior fibres of levator ani (inserted into the coccyx and the anococcygeal raphe). |
| 5. insertion of the most anterior fibres into the perineal body. (forms the levator prostatae). | 10. coccygeus. |

Fig.(377): MODE OF INSERTION
OF LEVATOR ANI

The most anterior fibres run backwards and downwards across the side of the prostate (or the vagina) to get inserted into the perineal body. The succeeding fibres form the pubo-rectalis which curves behind the rectum at the ano-rectal junction. The most posterior fibres are inserted into the side of the coccyx and anococcygeal raphe (ligament).

1. tendinous arch.
2. most anterior fibres (levator prostatae or sphincter vaginae).
3. pubo-rectalis.
4. most posterior fibres.

* The anococcygeal raphe is a fibrous band extending in the midline between the tip of the coccyx and the back of the anal canal at the ano-rectal junction.

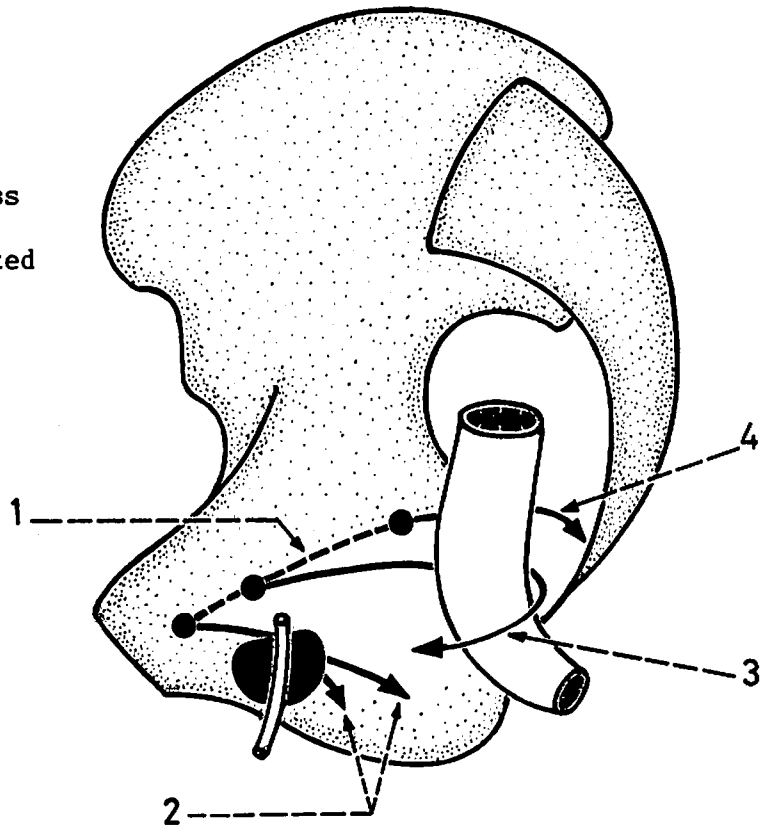
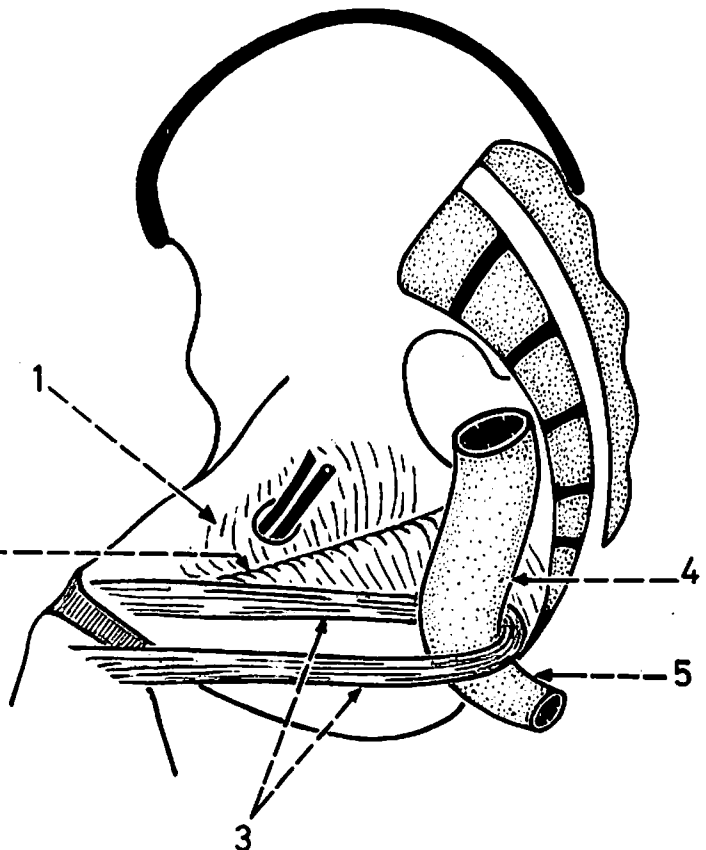


Fig.(378): PUBO-RECTALIS

It is a thick U-shaped part which loops behind the rectum at the ano-rectal junction (like a sling). It acts as an additional sphincter for the anal canal.

1. obturator internus.
2. tendinous arch (origin of the levator ani).
3. pubo-rectalis (belongs to the anterior part of the levator ani and sweeps backwards and downwards to join the corresponding part of the opposite side behind the ano-rectal junction).
4. rectum.
5. anal canal.



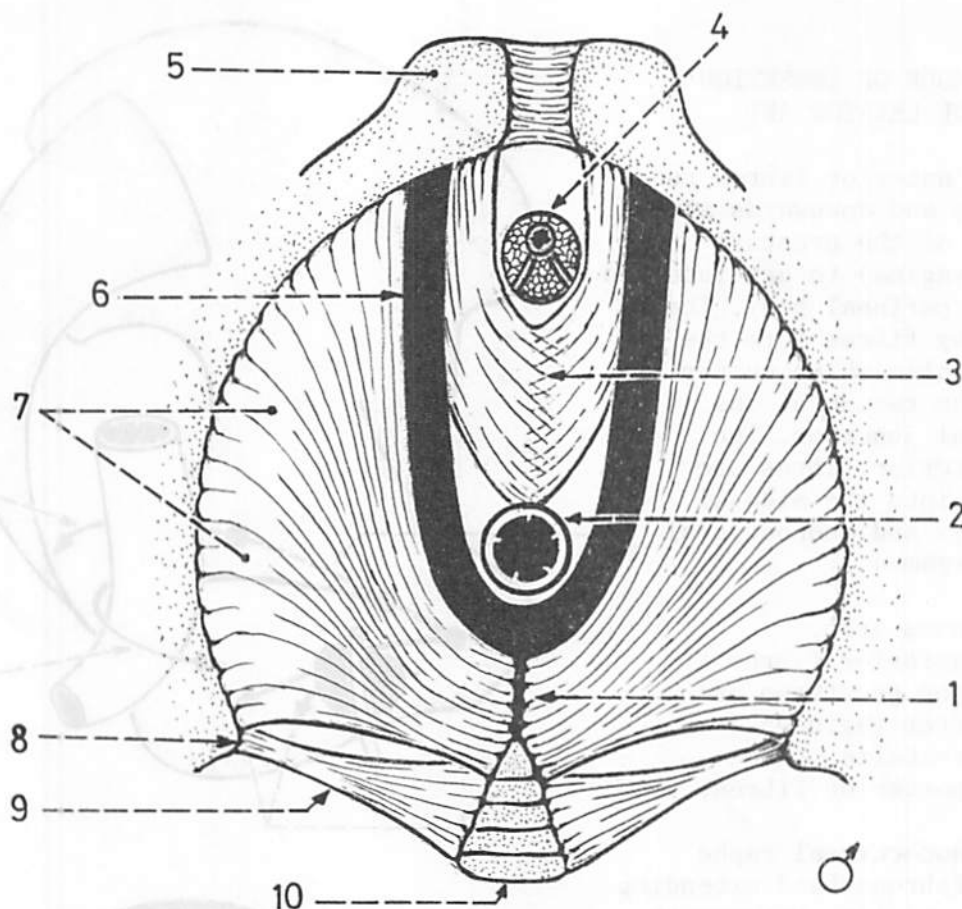


Fig.(379): PELVIC DIAPHRAGM IN THE MALE
(seen from above)

The pelvic diaphragm consists mainly of the levator ani of both sides and the 2 coccygeus muscles which lie behind the levator ani. The 2 coccygeus muscles are attached to the sides of the upper part of the coccyx, while the 2 levator ani muscles meet in the midline of the floor of the pelvis in front of the coccyx. The midline of the floor of the pelvis shows 2 gaps: a posterior gap close to the coccyx for transmission of the anal canal, and an anterior gap for transmission of the urethra; between these 2 gaps the muscle fibres of both sides meet in the perineal body.

1. ano-coccygeal raphe (between the coccyx and anal canal).
2. rectum at the ano-rectal junction.
3. perineal body.
4. prostate with the prostatic urethra (surrounded by the levator prostatae).
5. pubic bone.
6. pubo-rectalis (sling-like part curving around the ano-rectal junction).
7. middle and posterior fibres of levator ani converging towards their insertion into the coccyx and ano-coccygeal raphe.
8. ischial spine.
9. coccygeus forming the most posterior part of the pelvic diaphragm.
10. coccyx.

Fig.(380): PELVIC DIAPHRAGM IN THE FEMALE
(seen from above)

1. rectum.
2. perineal body.
3. pubo-rectalis.
4. most anterior fibres of levator ani.
5. anterior gap for vagina and urethra.
6. pubic bone.
7. urethra.
8. vagina surrounded by the sphincter vaginae.
9. tendinous arch (origin of levator ani).
10. posterior part of levator ani.
11. ischial spine.
12. ano-coccygeal raphe.
13. coccygeus.
14. coccyx.

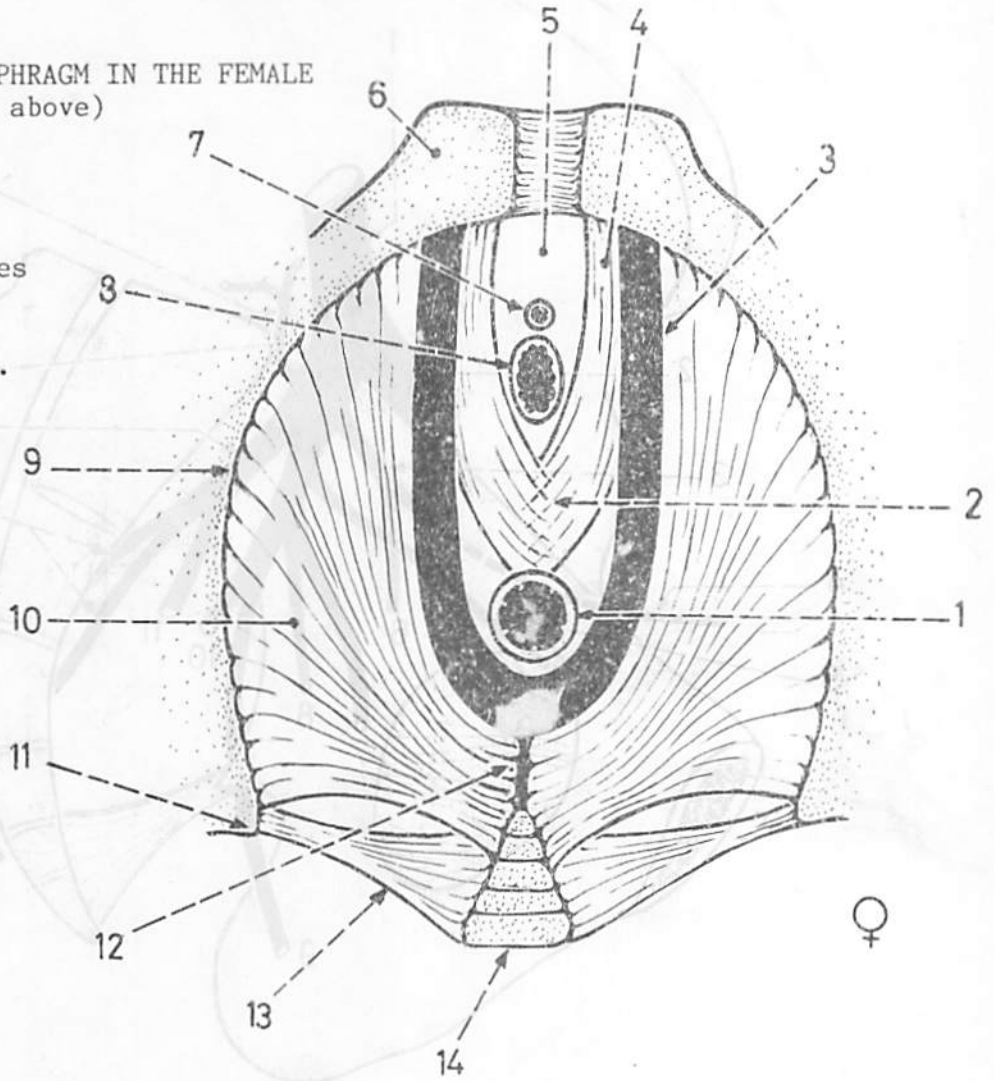
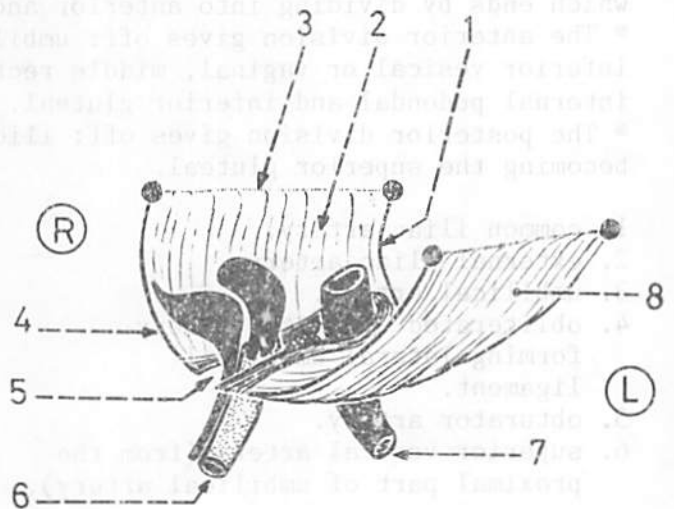


Fig.(381): PELVIC FLOOR SHOWING
THE 2 GAPS IN THE FEMALE

The meeting of the 2 levator ani muscles in the midline leaves 2 gaps for the rectum (posteriorly) and for both the vagina and urethra (anteriorly).

1. posterior border of levator ani.
2. right levator ani.
3. upper border of levator ani (origin).
4. anterior border of levator ani.
5. anterior gap for vagina and urethra.
6. vagina and urethra.
7. anal canal emerging through the posterior gap.
8. left levator ani.



VESSELS OF THE PELVIS

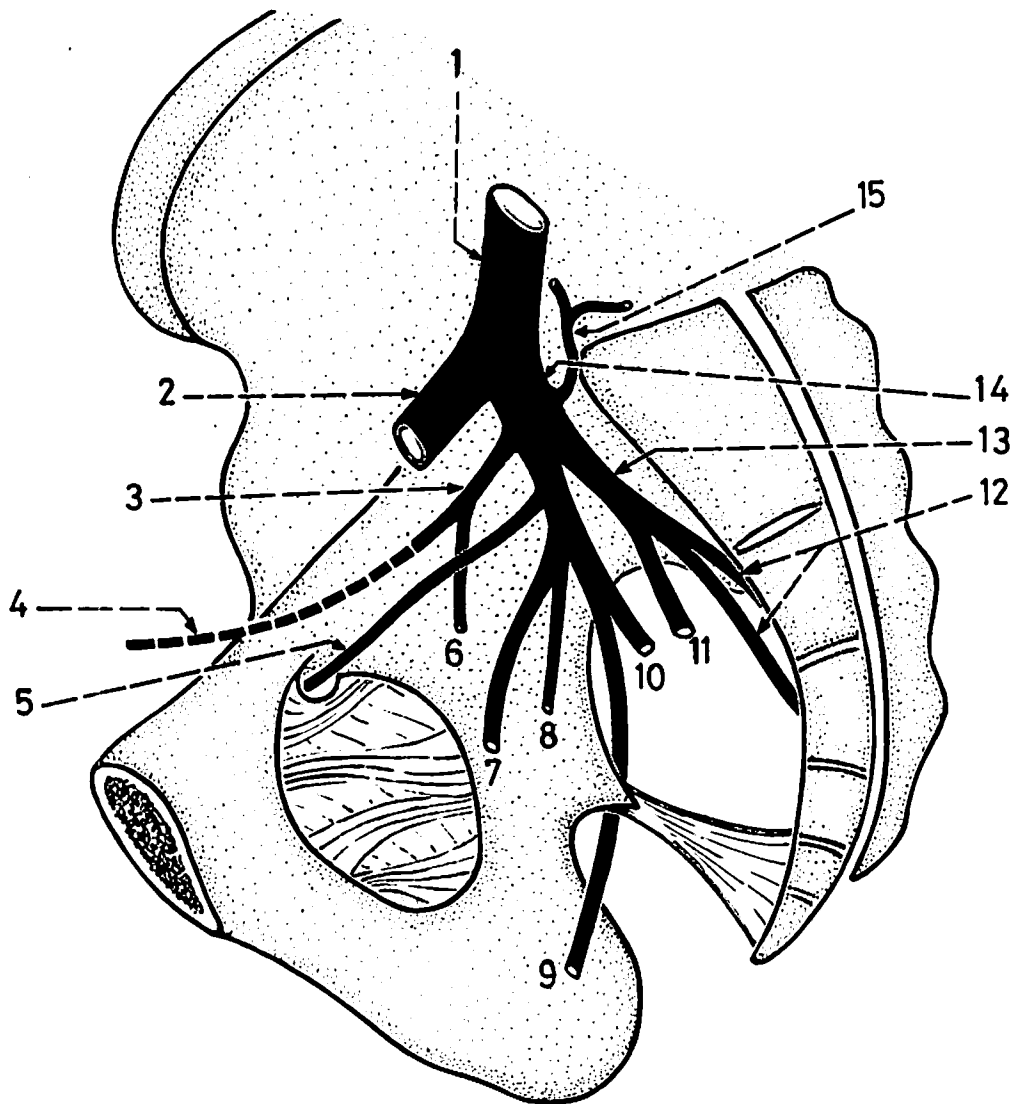


Fig.(382): BRANCHES OF INTERNAL ILIAC ARTERY

The internal iliac artery arises from the common iliac at the level of the promontory in front of the sacro-iliac joint. It is a short artery (4 cm long) which ends by dividing into anterior and posterior divisions.

* The anterior division gives off: umbilical, obturator, superior vesical, inferior vesical or vaginal, middle rectal and uterine and ends by giving the internal pudendal and inferior gluteal.

* The posterior division gives off: iliolumbar, 2 lateral sacral and ends by becoming the superior gluteal.

- | | |
|--|---|
| 1. common iliac artery. | 7. middle rectal artery. |
| 2. external iliac artery. | 8. inferior vesical or vaginal artery. |
| 3. umbilical artery. | 9. internal pudendal artery. |
| 4. obliterated umbilical artery forming lateral umbilical ligament. | 10. inferior gluteal artery. |
| 5. obturator artery. | 11. superior gluteal artery. |
| 6. superior vesical artery (from the proximal part of umbilical artery). | 12. lateral sacral arteries. |
| | 13. posterior division of internal iliac. |
| | 14. internal iliac artery. |
| | 15. iliolumbar artery. |

Fig.(383): RELATIONS OF INTERNAL ILIAC ARTERY

The internal iliac artery is related to the ureter and ovary (in front), to the internal iliac vein and lumbo-sacral trunk (behind) and to the obturator nerve (laterally).

1. ureter.
2. common iliac artery.
3. obturator nerve.
4. lumbo-sacral trunk.
5. internal iliac vein.
6. internal iliac artery.
7. ovary (in the female).

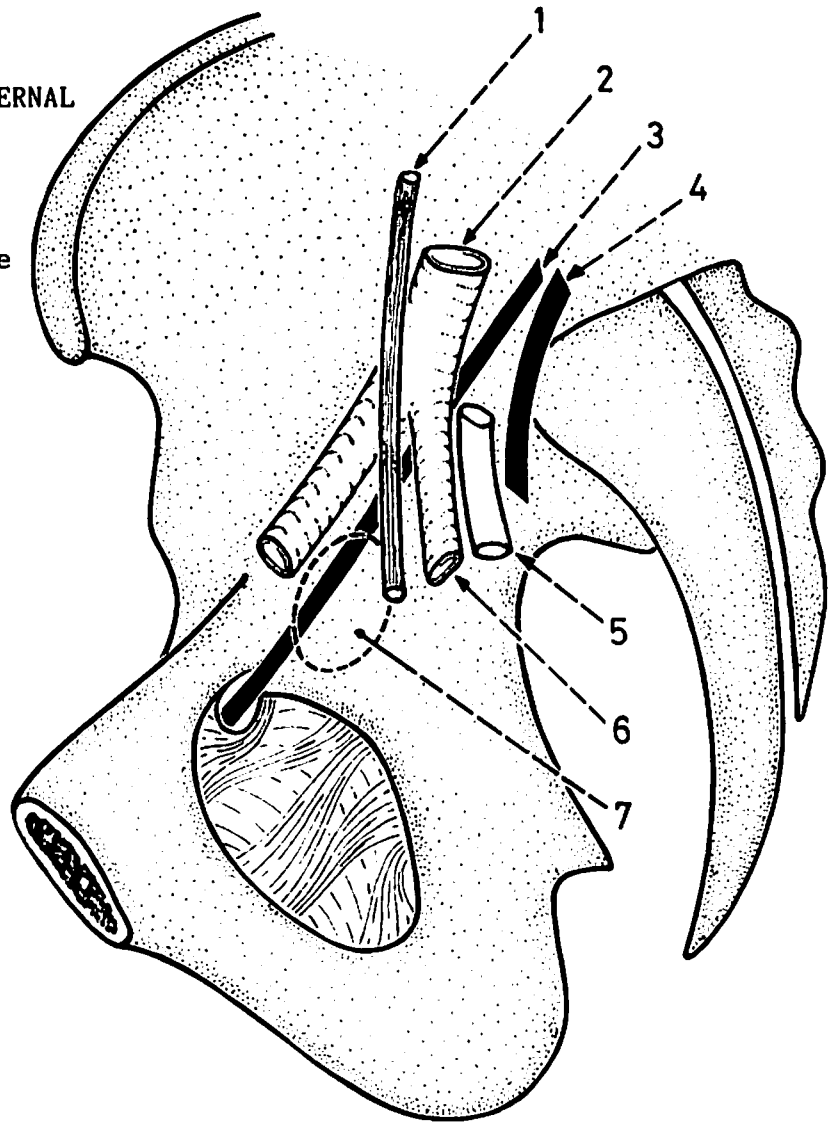


Fig.(384): SUPERIOR AND INFERIOR VESICAL ARTERIES

The superior vesical artery (may be more than one branch) supplies the upper part of the bladder and terminal part of the ureter. The inferior vesical artery supplies the base of the bladder and the related structures in addition to giving the artery to ductus deferens.

1. superior vesical branches.
2. urinary bladder.
3. inferior vesical artery.

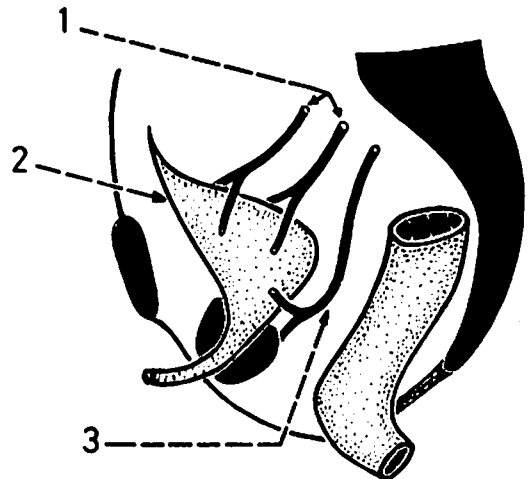


Fig.(385): OBTURATOR ARTERY

It passes forwards on the lateral wall of the pelvis (obturator internus) to enter the obturator canal. It is accompanied by the obturator nerve above it and by the obturator vein below it. Near the obturator canal it gives off its pubic branch which is the source of the abnormal obturator artery.

1. pubic branch of inferior epigastric artery.
2. pubic branch of obturator artery.
3. obturator canal.
4. obturator internus.
5. obturator vein.
6. obturator artery.
7. obturator nerve.

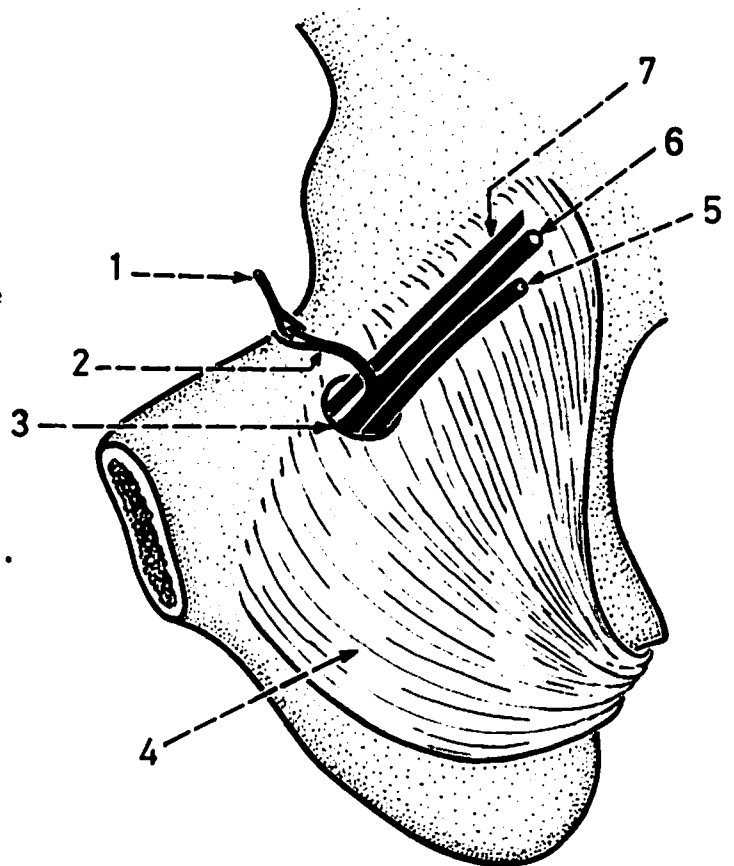


Fig. (386): INTERNAL PUDENDAL ARTERY

It leaves the pelvis through the greater sciatic foramen to enter the gluteal region. It crosses the back of the ischial spine and passes through the lesser sciatic foramen to enter the pudendal canal in the lateral wall of the ischio-rectal fossa. Its terminal branches continue in the deep and superficial perineal pouches.

1. dorsal artery of penis.
2. deep artery of penis.
3. urethral artery.
4. artery of the bulb.
5. artery of the penis.
6. transverse perineal artery.
7. posterior scrotal artery.
8. perineal artery.
9. pudendal canal.
10. internal pudendal artery.
11. inferior rectal artery.
12. pudendal nerve.
13. internal pudendal artery.
14. nerve to obturator internus.

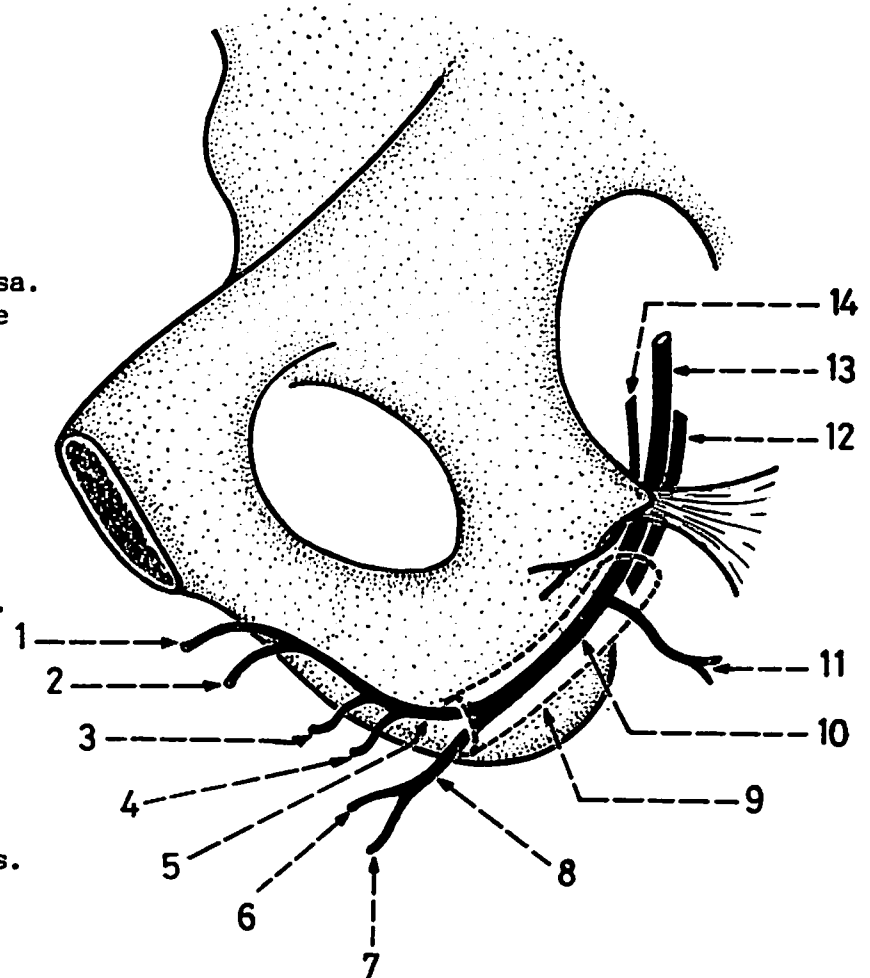
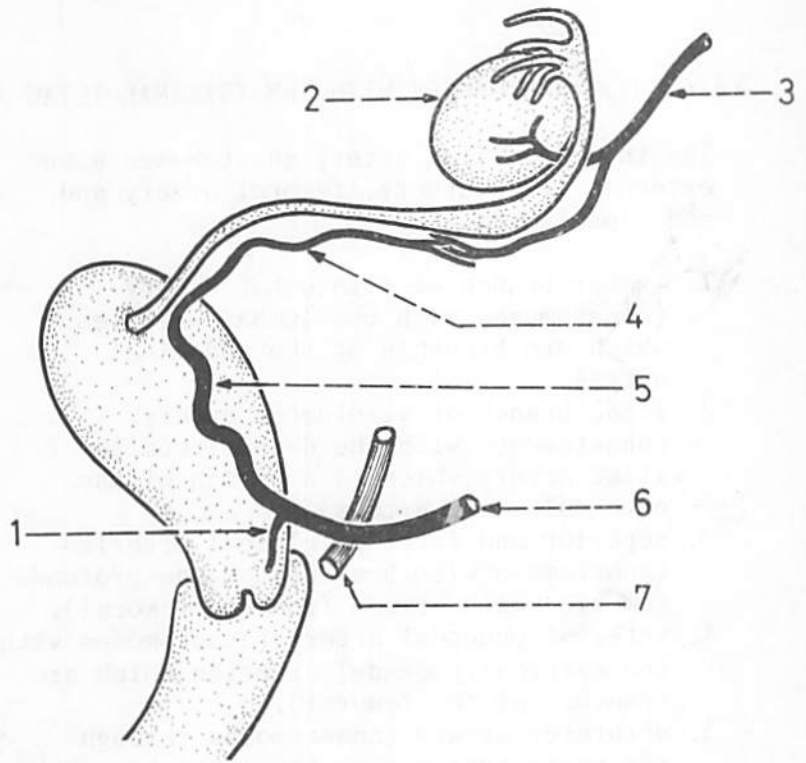


Fig.(387): UTERINE ARTERY

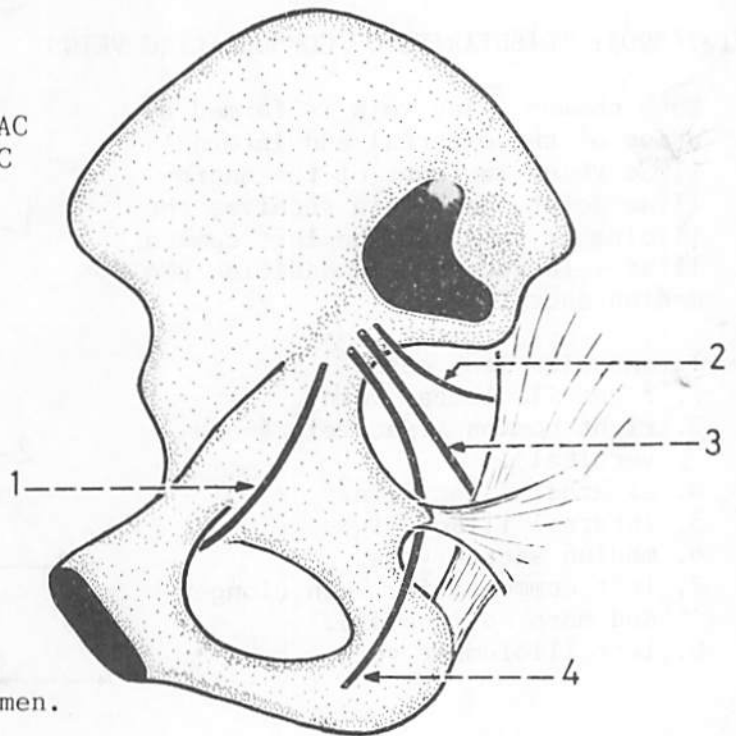
It runs medially on the floor of the pelvis where it crosses above the ureter about 2 cm from the cervix. It continues above the lateral fornix of the vagina to reach the cervix of the uterus where it ascends in a tortuous manner as far as the uterine tube. It curves laterally in the broad ligament just below and parallel to the uterine tube and ends by anastomosing with the ovarian artery.



1. a branch to the vagina.
2. ovary.
3. ovarian artery.
4. termination of uterine artery.
5. tortuous course of uterine artery on the side of uterus.
6. uterine artery on the floor of the pelvis.
7. ureter crossed by the uterine artery.

Fig.(388): BRANCHES OF INTERNAL ILIAC ARTERY LEAVING THE PELVIC CAVITY

These are: obturator, internal pudendal, inferior gluteal and superior gluteal arteries. They leave the pelvic cavity to enter the lower limb and the perineum.



1. obturator artery: leaves the pelvis through the obturator canal.
2. superior gluteal artery: leaves the pelvis through the greater sciatic foramen.
3. inferior gluteal artery: emerges through the greater sciatic foramen.
4. internal pudendal artery: leaves through the greater sciatic foramen then enters the pudendal canal through the lesser sciatic foramen.

Fig.(389): ANASTOMOSES WITH THE INTERNAL ILIAC ARTERY

The internal iliac artery anastomoses with external iliac artery, femoral artery and abdominal aorta.

1. lumbar branch of iliolumbar artery (anastomoses with the lumbar arteries which are branches of the abdominal aorta).
2. iliac branch of iliolumbar artery (anastomoses with the deep circumflex iliac artery which is a branch of the external iliac artery).
3. superior and inferior gluteal arteries (anastomose with branches of the profunda femoris which arise from the femoral).
4. internal pudendal artery (anastomoses with the external pudendal arteries which are branches of the femoral).
5. obturator artery (anastomoses through its pubic branch with the pubic branch of the inferior epigastric artery which is a branch from the external iliac artery).

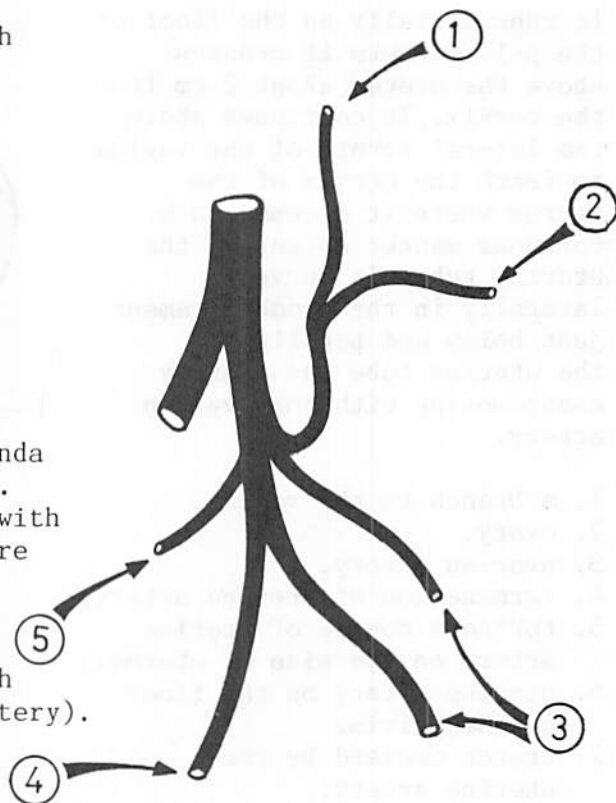
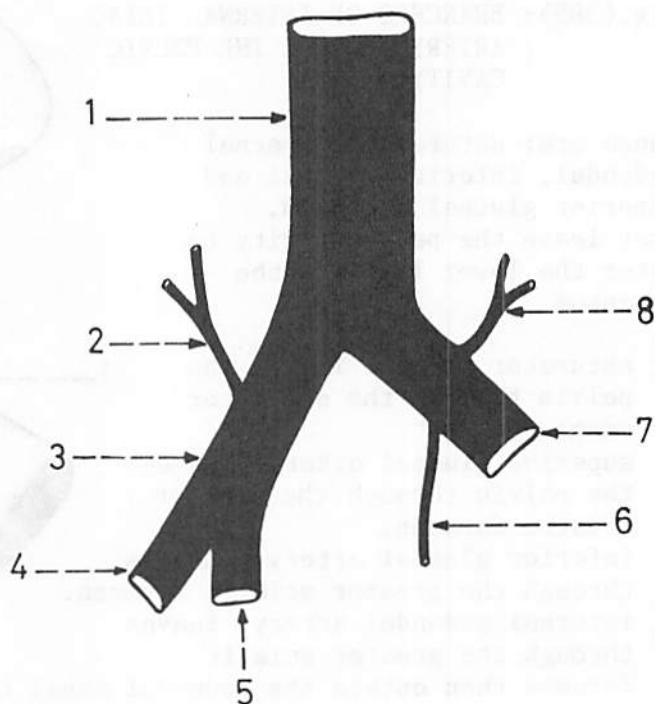


Fig.(390): TRIBUTARIES OF COMMON ILIAC VEINS

Each common iliac vein is formed by union of the external and internal iliac veins in front of the sacroiliac joint. Each vein receives the iliolumbar vein and the left common iliac vein receives in addition the median sacral vein.

1. inferior vena cava.
2. right iliolumbar vein.
3. right common iliac vein (more vertical).
4. external iliac vein.
5. internal iliac vein.
6. median sacral vein.
7. left common iliac vein (longer and more horizontal).
8. left iliolumbar vein.



NERVES OF THE PELVIS

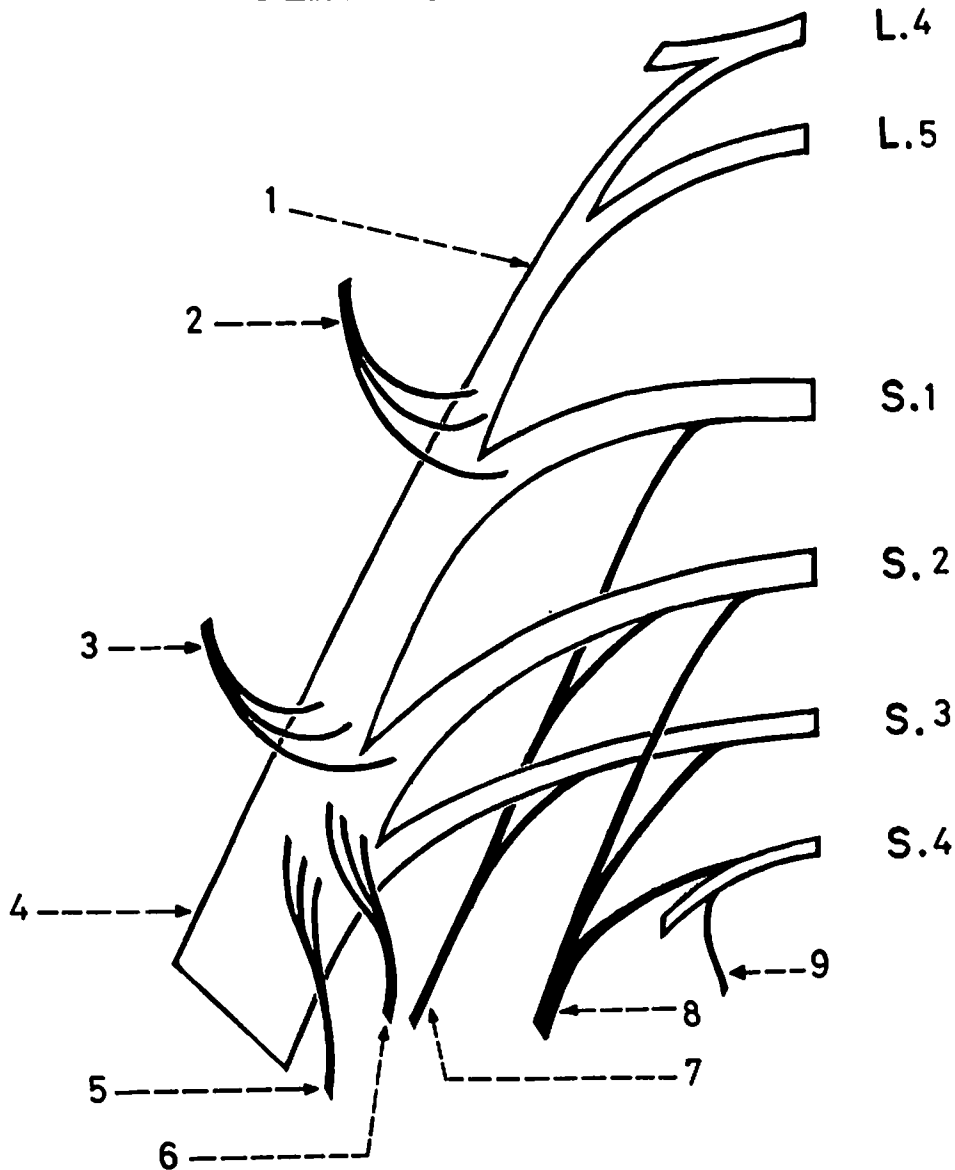


Fig.(391): FORMATION OF THE SACRAL PLEXUS

The sacral plexus is formed by the ventral rami of the 5th lumbar and upper 3 sacral nerves, with contributions from the 4th lumbar and 4th sacral nerves. The contribution from the 4th lumbar joins the 5th lumbar to form the lumbo-sacral trunk.

The nerves of the plexus converge towards the greater sciatic foramen where they unite to form a flattened band which continues as the sciatic nerve.

1. lumbo-sacral trunk (L.4,5).
2. superior gluteal nerve (L.4,5, S.1).
3. inferior gluteal nerve (L.5, S.1,2).
4. sciatic nerve (L.4,5, S.1,2,3).
5. nerve to quadratus femoris (L.4,5, S.1).
6. nerve to obturator internus (L.5, S.1,2).
7. posterior cutaneous nerve of thigh (S.1,2,3).
8. pudendal nerve (S.2,3,4).
9. nerve to levator ani (S.4).

Fig.(392): THE SACRAL PLEXUS AS IT LEAVES THE PELVIS

1. lumbo-sacral trunk.
2. greater sciatic foramen.
3. flattened band formed by union of the nerves of the sacral plexus.
4. nerve to obturator internus passing through the lesser sciatic foramen.
5. pudendal nerve passing through the lesser sciatic foramen.
6. lesser sciatic foramen.
7. sacrospinous ligament.

* Note that all the branches of the sacral plexus leave the pelvic cavity through the greater sciatic foramen to enter the gluteal region.

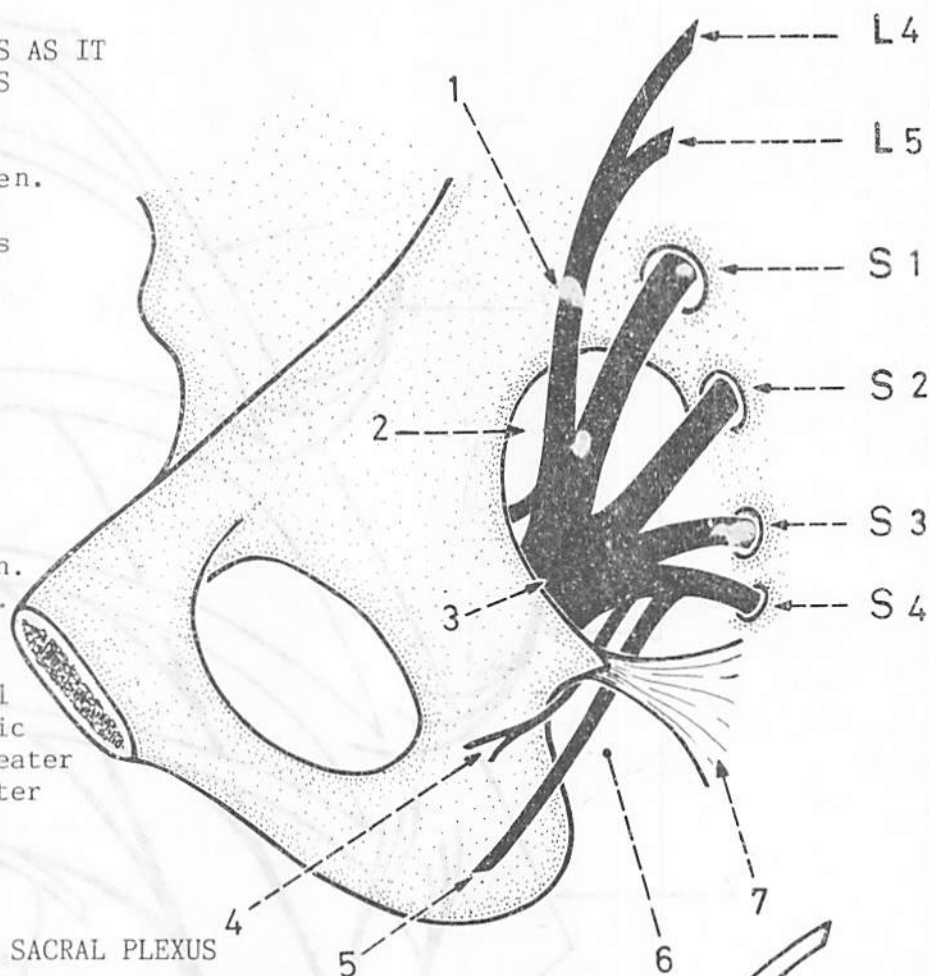


Fig.(393): RELATIONS OF THE SACRAL PLEXUS

The sacral plexus lies in front of the piriformis where it is closely related to branches of the internal iliac artery: superior gluteal, inferior gluteal and internal pudendal arteries.

1. lumbo-sacral trunk.
2. superior gluteal artery (passes between S.1 and S.2).
3. superior gluteal nerve (accompanies its artery).
4. piriformis.
5. sciatic nerve.
6. inferior gluteal nerve (accompanies its artery).
7. inferior gluteal artery (passes between S.2 and S.3).
8. internal pudendal artery (passes in front of the roots of the plexus).
9. pudendal nerve (accompanies the internal pudendal artery).

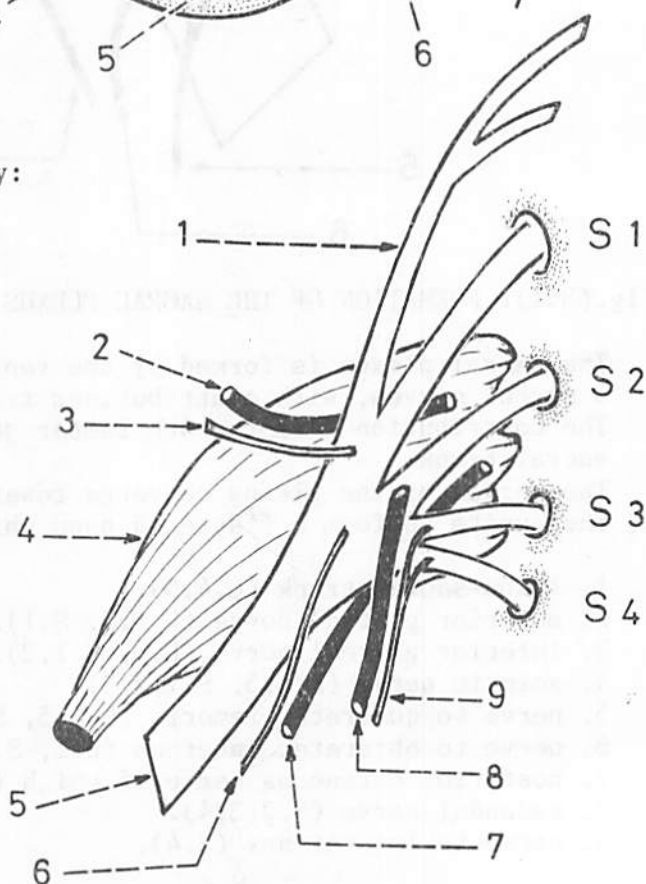


Fig.(394): PELVIC PART OF SYMPATHETIC TRUNKS

Each sympathetic trunk descends in front of the sacrum just medial to the anterior sacral foramina. The 2 trunks unite on the front of the coccyx to form a single ganglion called ganglion impar. Each trunk has 4-5 ganglia which give grey rami communicantes to the sacral nerves but they do not receive white rami communicantes.

1. lumbo-sacral trunk (descends in front of the ala of the sacrum).
2. roots of sacral plexus.
3. grey ramus communicans (postganglionic).
4. ganglion impar.
5. left sympathetic trunk.

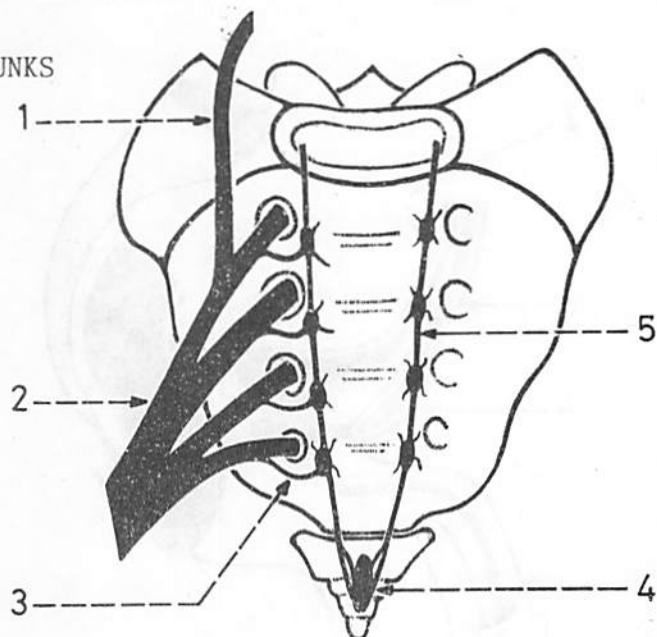
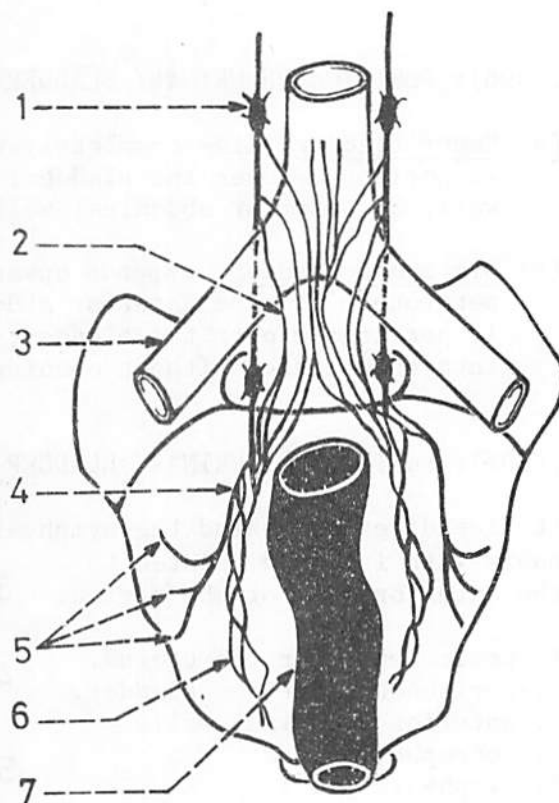


Fig.(395): SUPERIOR AND INFERIOR HYPOGASTRIC PLEXUSES

These are autonomic plexuses which supply pelvic organs. The superior hypogastric plexus lies in front of the bifurcation of the aorta and extends down to the promontory of the sacrum, between the 2 common iliac arteries. It divides into right and left parts which are continuous below with the right and left inferior hypogastric plexuses. These inferior hypogastric plexuses lie on the right and left sides of the rectum, bladder and prostate (in the male), cervix and vagina (in the female).

1. sympathetic trunk.
2. superior hypogastric plexus.
3. common iliac artery.
4. inferior hypogastric plexus.
5. roots of the pelvic splanchnic nerve (S.2,3,4) which is parasympathetic and ascends in the hypogastric plexuses.
6. middle rectal plexus (from the inferior hypogastric plexus to the rectum).
7. rectum.



URINARY BLADDER

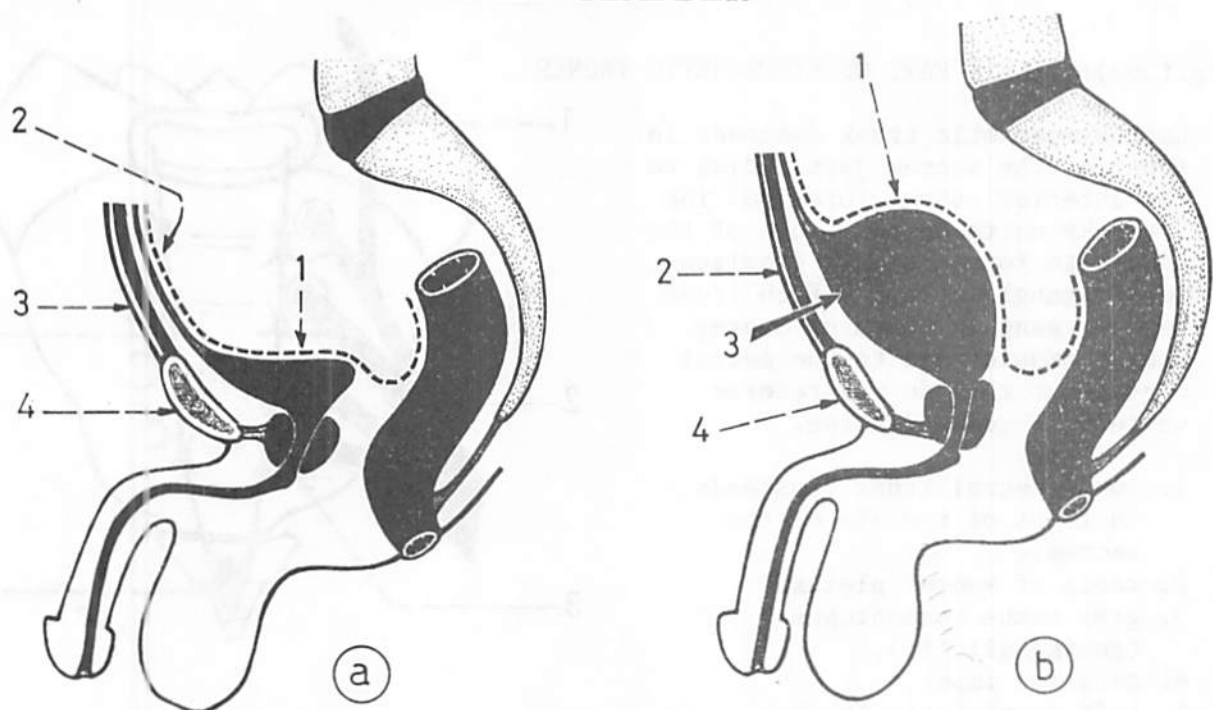


Fig.(396): POSITION OF URINARY BLADDER IN THE MALE

- (a) Empty bladder: lies completely within the lesser pelvis.
 1. peritoneum over the bladder; 2. peritoneum lining anterior abdominal wall; 3. anterior abdominal wall; 4. symphysis pubis.
- (b) Distended bladder: expands upwards into the abdominal cavity stripping the peritoneum off the anterior abdominal wall.
 1. peritoneum over the bladder; 2. anterior abdominal wall; 3. arrow passing into the bladder without opening the peritoneal cavity; 4. symphysis pubis.

Fig.(397): POSITION OF URINARY BLADDER IN THE FEMALE

It lies directly behind the symphysis pubis with its base related to the anterior wall of the vagina.

1. peritoneum over the uterus.
2. peritoneum over the bladder.
3. anterior abdominal wall.
4. retropubic space.
5. symphysis pubis.
6. pubo-vesical ligament.
7. urethra.
8. vagina.
9. perineal body.

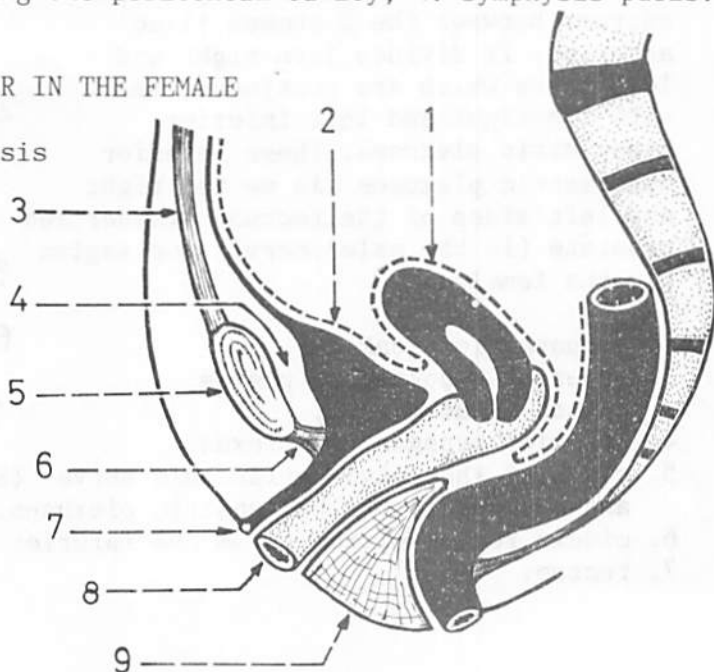
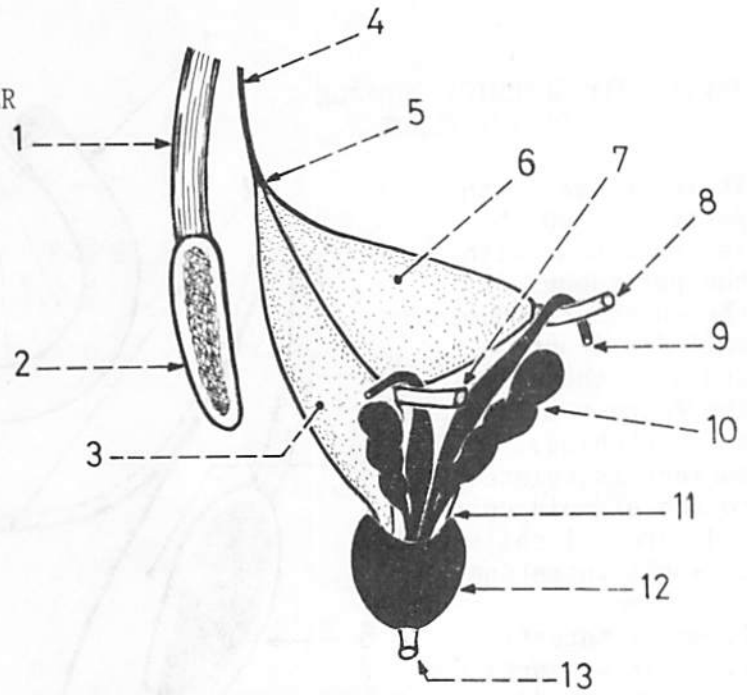


Fig.(398): SHAPE OF URINARY BLADDER

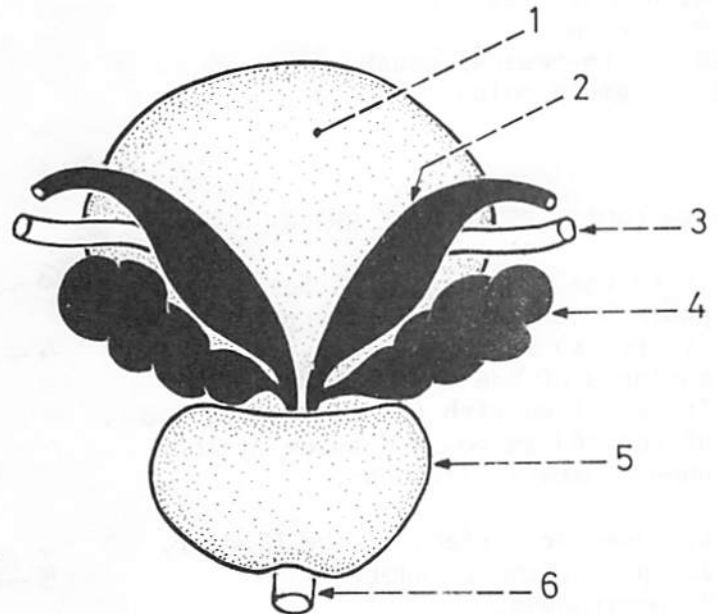
The bladder has 4 surfaces, apex and neck. The surfaces are: superior surface (directed upwards and covered with peritoneum), 2 infero-lateral surfaces (directed downwards and laterally and not covered with peritoneum) and base (directed backwards and not covered with peritoneum). The apex is directed forwards opposite the upper part of the symphysis pubis and is continuous with the median umbilical ligament. The neck is directed downwards and lies 2 inches behind the lower part of the symphysis pubis.



1. anterior abdominal wall.
2. symphysis pubis.
3. infero-lateral surface.
4. median umbilical ligament (obliterated urachus).
5. apex of the bladder.
6. superior surface.
7. base of the bladder.
8. terminal part of the ureter.
9. ductus deferens.
10. seminal vesicle.
11. neck of the bladder.
12. prostate gland.
13. urethra.

Fig.(399): BASE OF THE BLADDER IN THE MALE

It is directed backwards and is separated from the rectum by the rectovesical pouch. It is not covered with peritoneum and is directly related to the 2 seminal vesicles and the 2 deferent ducts leaving its middle part free.



- | | |
|-----------------------------|---------------------|
| 1. middle part of the base. | 4. seminal vesicle. |
| 2. ductus deferens. | 5. prostate. |
| 3. ureter. | 6. urethra. |

Fig.(400): SUPERIOR SURFACE
OF THE BLADDER

It is covered with peritoneum which is continuous with the peritoneum of the anterior abdominal wall (in front), and with that of the recto-vesical pouch (behind). This surface is related to the sigmoid colon and terminal coils of small intestine.

1. small intestine.
2. superior surface of the bladder.
3. anterior abdominal wall.
4. retropubic space.
5. symphysis pubis.
6. pubo-prostatic ligament.
7. prostate.
8. seminal vesicle.
9. rectum.
10. recto-vesical pouch.
11. sigmoid colon.

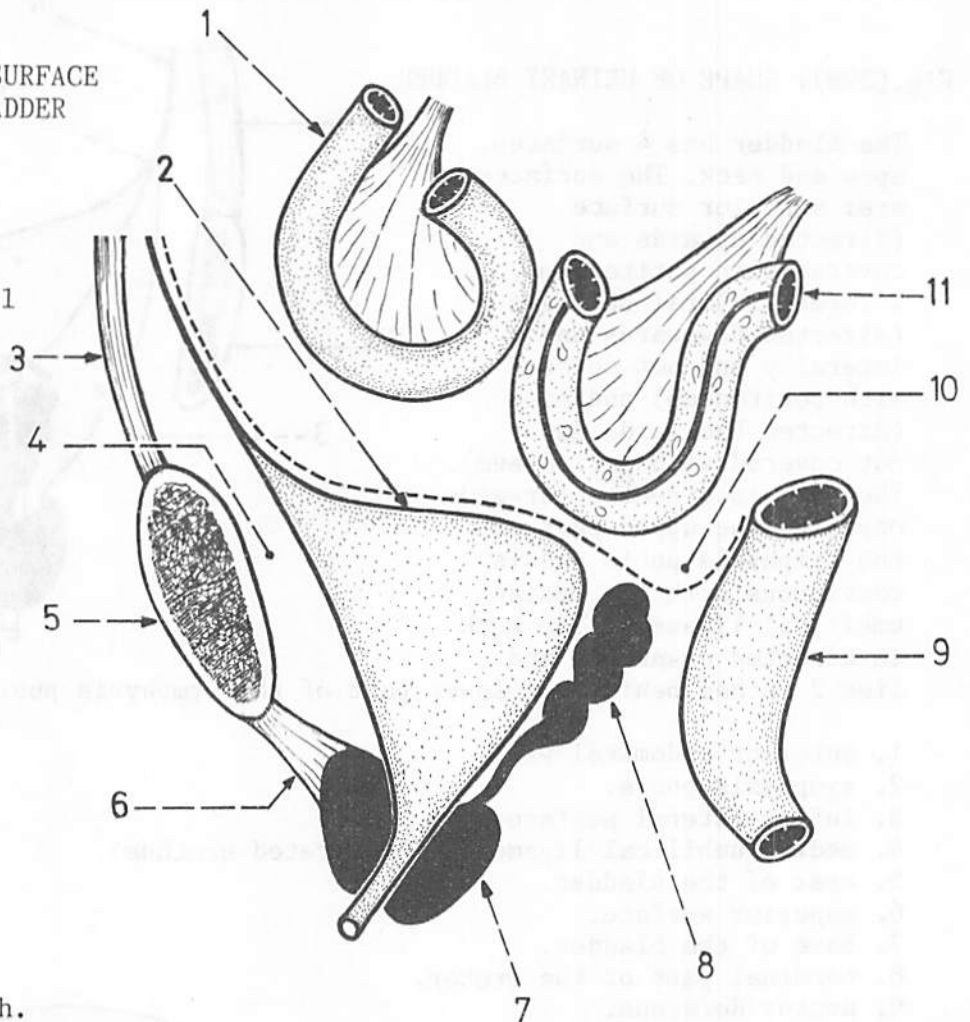


Fig.(401): RETROPUBIC SPACE

It is the space situated between the pubic bones and symphysis pubis (in front) and the infero-lateral surfaces of the bladder (behind). It is filled with the retropubic pad of fat and is bounded below by the pubo-prostatic ligament.

1. superior surface of the bladder.
2. apex of the bladder.
3. peritoneum.
4. median umbilical ligament.
5. symphysis pubis.
6. retropubic space.
7. neck of the bladder.
8. pubo-prostatic ligament.
9. uvula of the bladder.
10. base of the bladder.

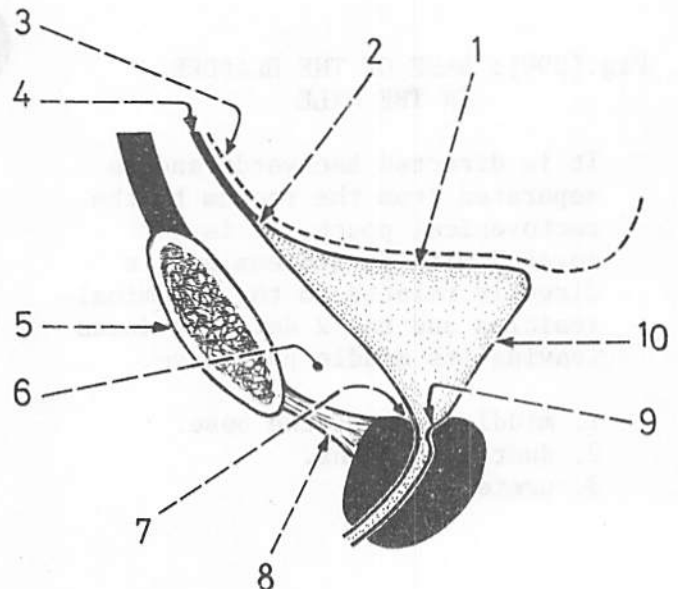
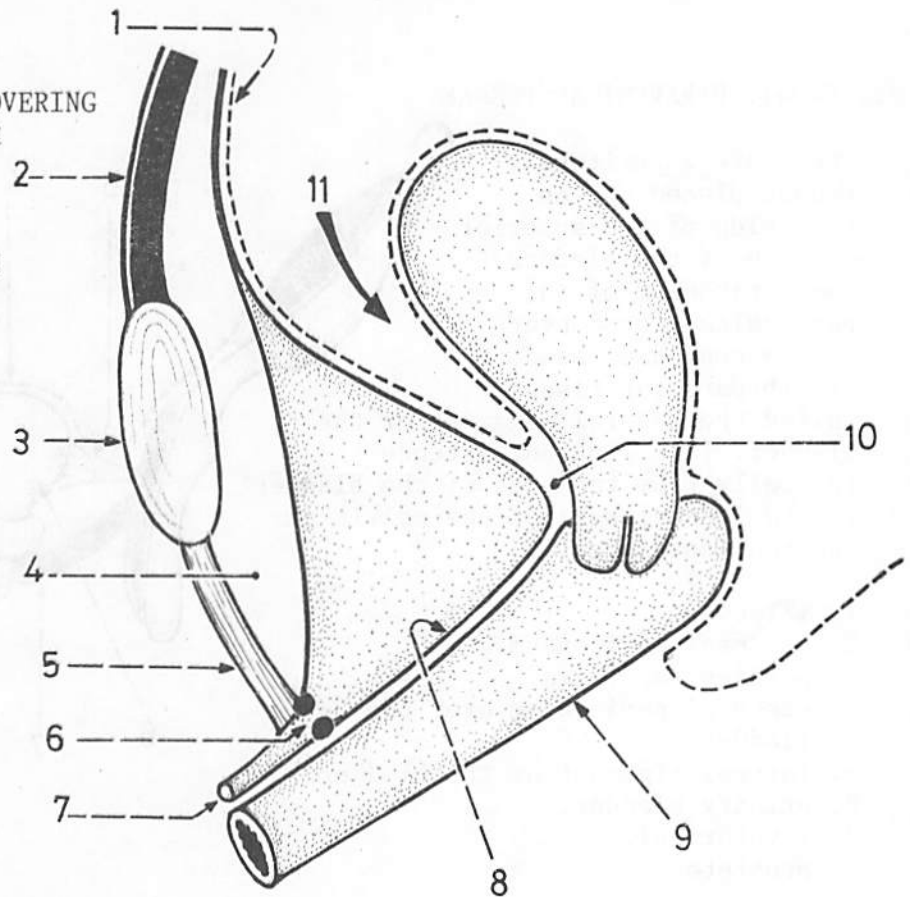


Fig.(402): PERITONEAL COVERING
OF THE BLADDER
IN THE FEMALE

The superior surface of the bladder is covered with peritoneum which is continuous with the peritoneum on the anterior surface of the uterus forming the utero-vesical pouch. The posterior part of this surface is in direct contact with the front of the supra-vaginal part of the cervix with no peritoneum in between.



1. peritoneum.
2. anterior abdominal wall.
3. symphysis pubis.
4. retropubic space (bounded below by the pubo-vesical ligament).
5. pubo-vesical ligament.
6. neck of the bladder.
7. urethra.
8. posterior wall of the bladder.
9. vagina.
10. area devoid of peritoneum.

Fig.(403): INTERIOR OF THE BLADDER

1. folded mucous membrane.
2. interureteric ridge (forms the base of the trigone).
3. ureteric orifice.
4. trigone of the bladder (a triangular area on the posterior wall of the bladder with a smooth lining).
5. uvula of the bladder (at the apex of the trigone).
6. neck of the bladder.
7. prostate.
8. external urethral sphincter.
9. prostatic urethra.

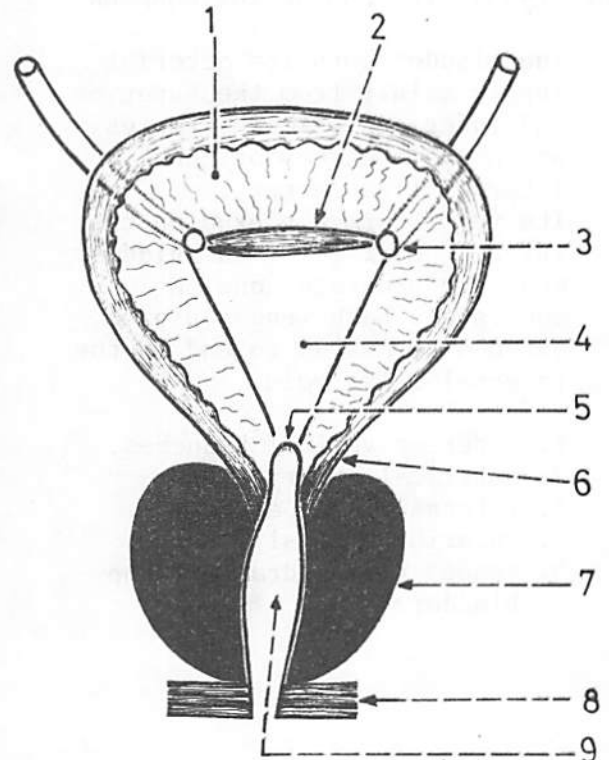


Fig.(404): PARAVESICAL FOSSAE

These are 2 peritoneal fossae placed one on each side of the superior surface of the bladder. The peritoneum of the paravesical fossa overlies a condensed band of fibroareolar tissue called the lateral ligament of the bladder. This ligament extends laterally from the side of the bladder to the lateral wall of the pelvis at the tendinous arch.

1. iliacus.
2. parietal peritoneum.
3. paravesical fossa.
4. visceral peritoneum over the bladder.
5. lateral ligament of the bladder.
6. urinary bladder.
7. levator ani.
8. prostate.

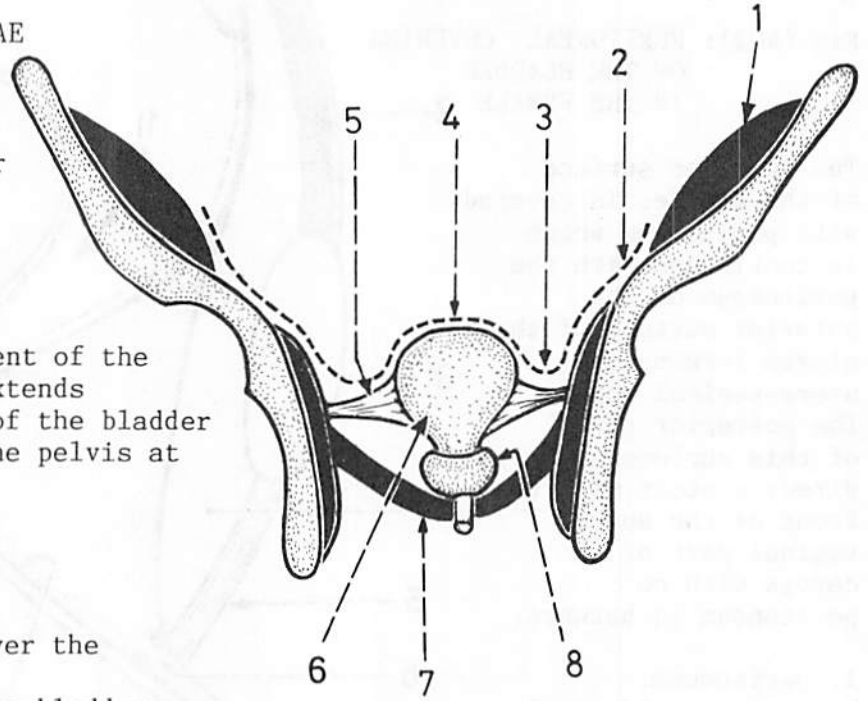


Fig.(405): VESSELS OF THE BLADDER

The bladder gets its arterial supply mainly from the superior and inferior vesical arteries which are branches of the internal iliac artery. Its veins form a plexus on the inferior surface of the bladder near the prostate, one on each side. Each venous plexus extends backwards to end in the internal iliac vein.

1. superior vesical branches.
2. umbilical artery.
3. internal iliac artery.
4. inferior vesical artery.
5. venous plexus draining the bladder.

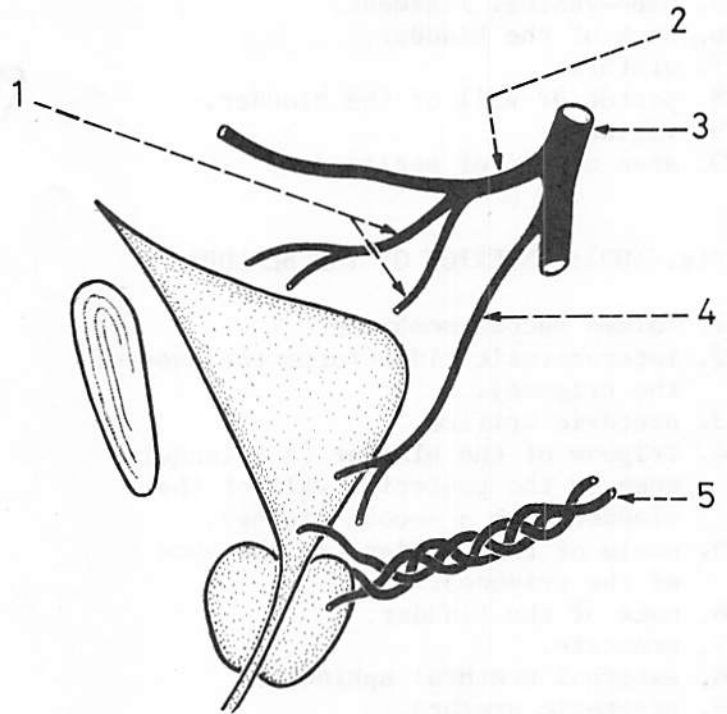


Fig.(406): LYMPHATIC DRAINAGE OF THE BLADDER

The lymph vessels from the bladder end in the external iliac lymph nodes.

1. symphysis pubis.
2. urinary bladder.
3. external iliac lymph nodes.

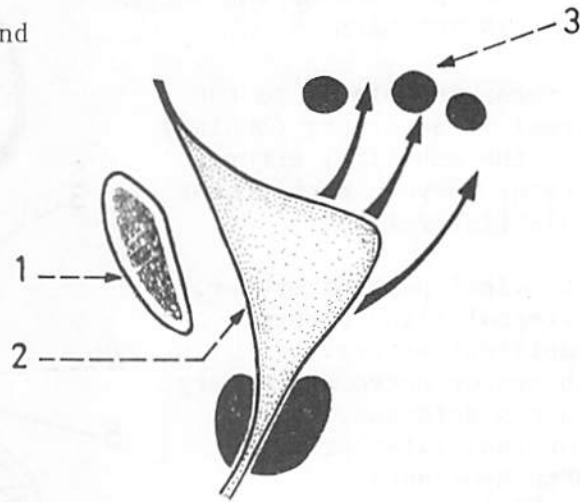
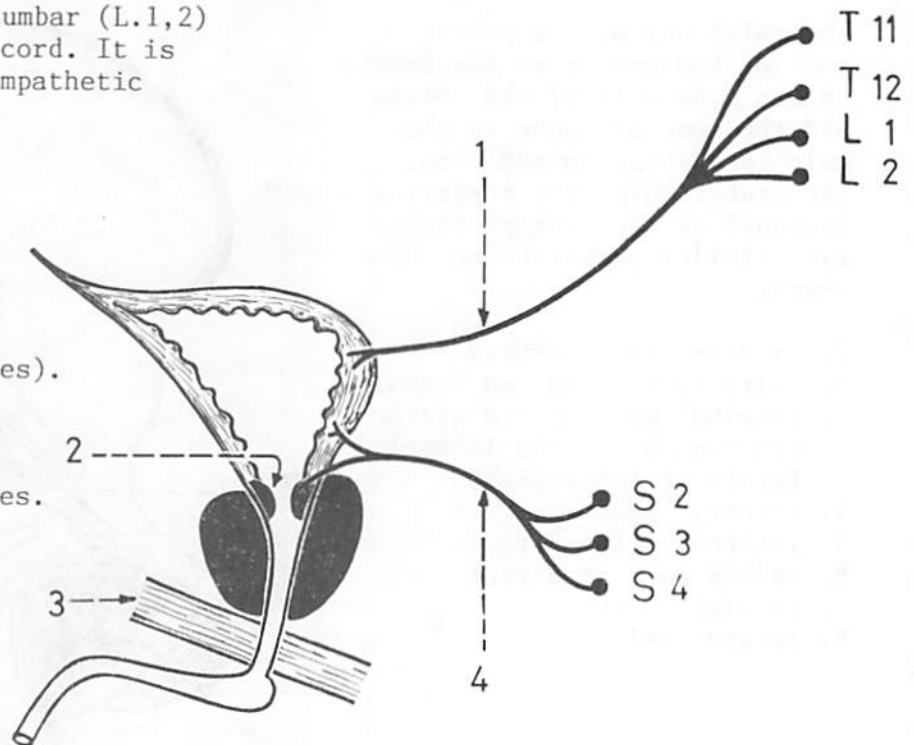


Fig.(407): NERVE SUPPLY OF THE BLADDER

The bladder is supplied by sympathetic fibres from the lower 2 thoracic (T.11,12) and upper 2 lumbar (L.1,2) segments of the spinal cord. It is also supplied by parasympathetic fibres derived from the pelvic splanchnic nerve (S.2,3,4).

1. sympathetic fibres.
2. sphincter vesicae (receives inhibitory fibres from the parasympathetic nerves).
3. external urethral sphincter(sphincter urethrae).
4. parasympathetic fibres.



PELVIC PART OF URETER

Fig.(408): RELATIONS OF THE URETER
ON THE SIDE OF THE PELVIS
IN THE MALE

The ureter is related to the internal iliac artery (behind) and to the umbilical artery, obturator nerve and obturator vessels (laterally).

1. abdominal part of ureter.
2. external iliac artery.
3. umbilical artery.
4. obturator nerve and artery.
5. ductus deferens.
6. internal iliac artery.
7. obturator nerve.
8. ischial spine.
9. pelvic part of ureter.
10. levator ani.

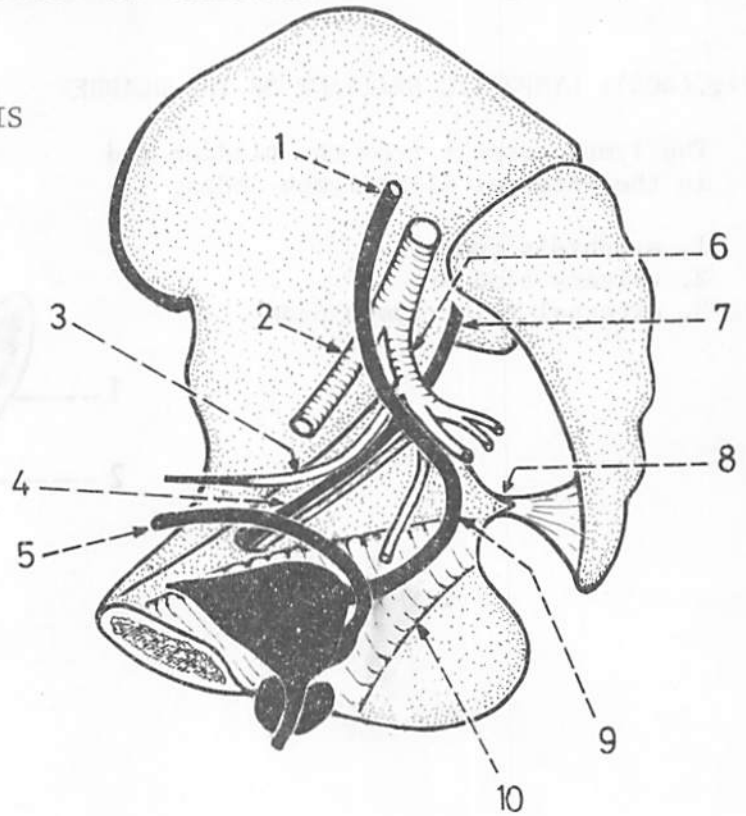


Fig.(409): RELATIONS OF THE URETER
ON THE SIDE OF THE PELVIS
IN THE FEMALE

The relations of the pelvic part of the ureter in the female on the side wall of the pelvis are the same as those in the male (Fig.408). In addition, the ureter forms the posterior boundary of the ovarian fossa, i.e. it lies posterior to the ovary.

1. external iliac artery.
2. ovary in the ovarian fossa.
3. terminal part of the ureter crossing above the lateral fornix of the vagina.
4. urinary bladder.
5. internal iliac artery.
6. pelvic part of ureter.
7. ischial spine.
8. levator ani.

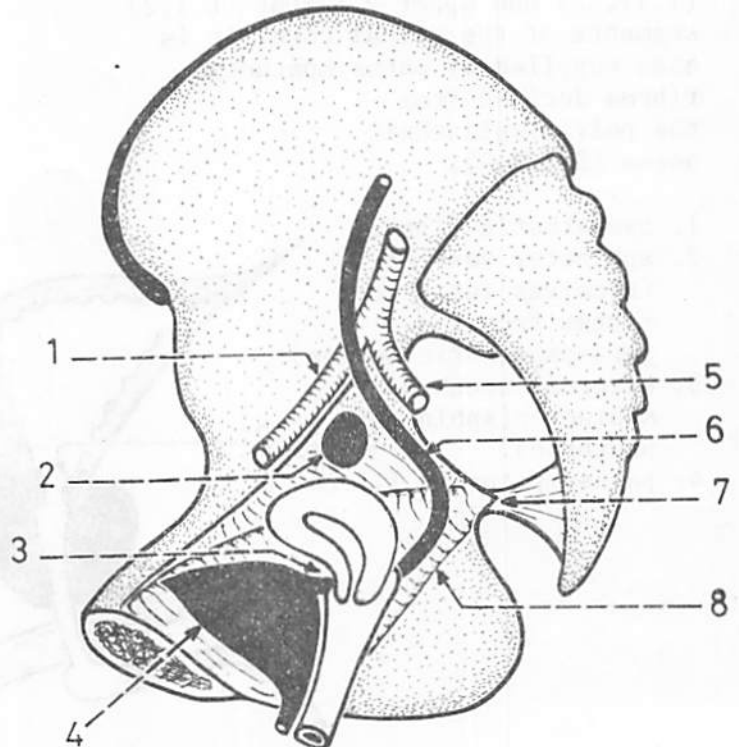


Fig.(410): COURSE OF THE URETER
IN THE PELVIS

It runs at 1st downwards and slightly backwards on the side wall of the pelvis till the ischial spine. It then runs forwards and medially on the floor of the pelvis to reach the bladder.

1. beginning of the pelvic part of ureter.
2. internal iliac artery.
3. the ureter passing downwards to the ischial spine.
4. ischial spine.
5. the ureter passing forwards and medially on the floor of the pelvis.
6. levator ani (floor of the pelvis).

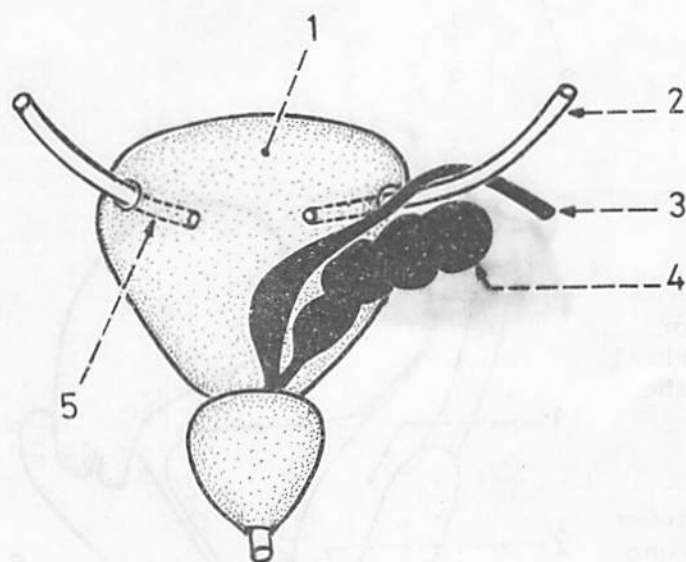
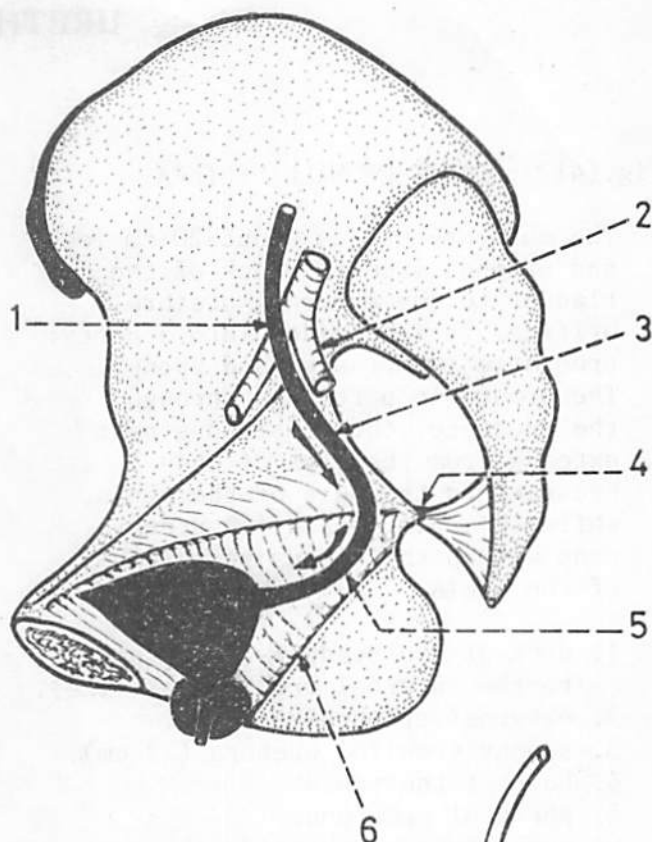


Fig.(411): RELATIONS OF THE TERMINAL
PART OF THE MALE URETER

1. urinary bladder.
2. terminal part of ureter.
3. ductus deferens crossing over the ureter.
4. seminal vesicle (just below the ureter).
5. intramural part of ureter.

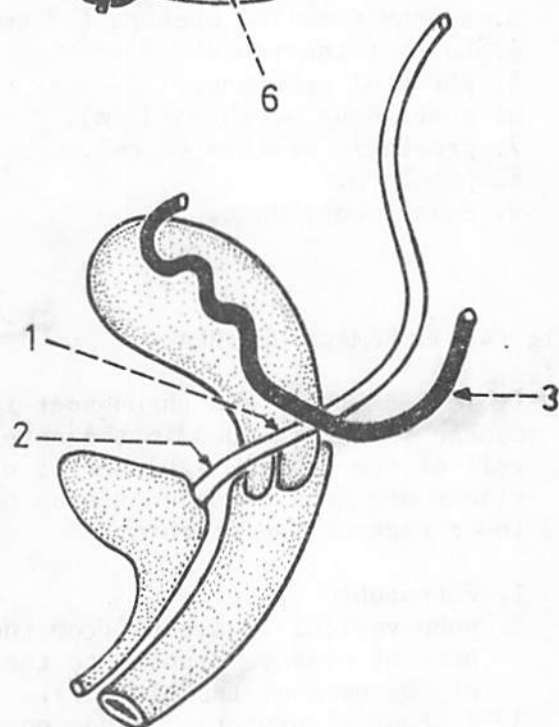


Fig.(412): RELATIONS OF THE TERMINAL
PART OF THE FEMALE URETER

1. ureter lateral to the cervix and above the lateral fornix of the vagina.
2. ureter in front of the vagina.
3. uterine artery crossing above the ureter.

URETHRA

Fig.(413): PARTS OF MALE URETHRA

The male urethra is about 20 cm long and extends from the neck of the bladder to the external urethral orifice. It is divided into 3 parts: prostatic, membranous and spongy. The prostatic part runs through the prostate, the membranous part extends from the apex of the prostate to the bulb of the penis, while the spongy (penile) urethra runs within the corpus spongiosum of the penis.

1. neck of the bladder (corresponds to the internal urethral orifice).
2. external urethral orifice.
3. spongy (penile) urethra (12 cm).
4. bulb of the penis.
5. perineal membrane.
6. membranous urethra (2 cm).
7. prostatic urethra (3 cm).
8. prostate.
9. ejaculatory duct.

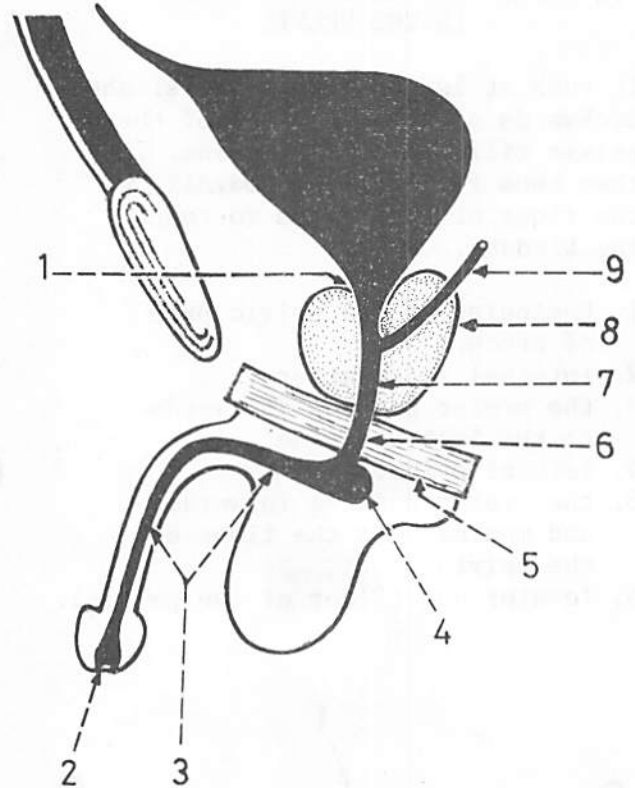


Fig.(414): FEMALE URETHRA

It is 5 cm long, and throughout its course it is embedded in the anterior wall of the vagina. A number of urethral glands are grouped on each side of the lower part of the urethra.

1. retropubic space.
2. pubo-vesical ligament (from the lower part of symphysis pubis to the front of the neck of the bladder).
3. a group of urethral glands on the side of the lower part of the urethra.
4. external urethral orifice.
5. vagina.
6. sphincter vesicae (surrounds the neck of the bladder).

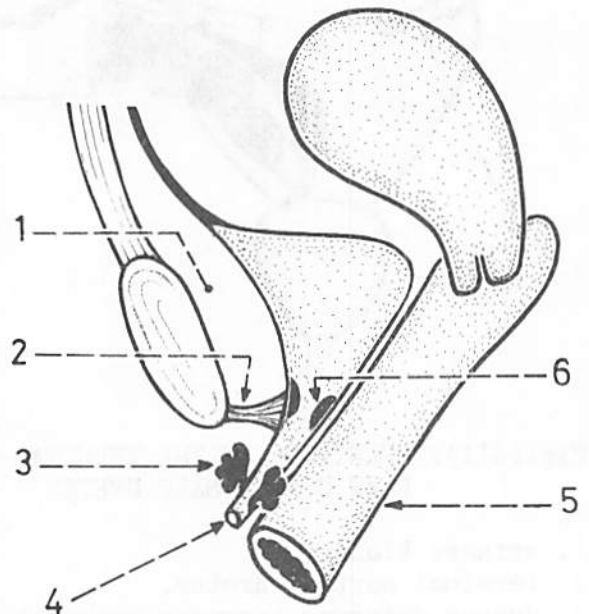
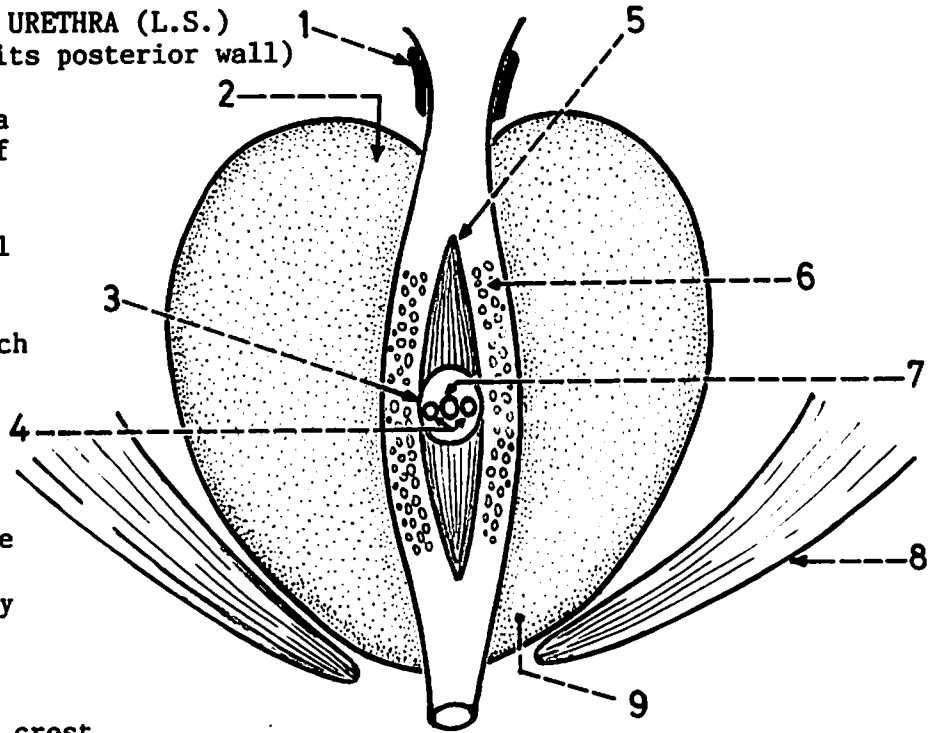


Fig.(415): PROSTATIC URETHRA (L.S.)
(to show its posterior wall)

The prostatic urethra is the widest part of the urethra. Its posterior wall shows a median longitudinal elevation termed the urethral crest, at the middle of which lies the seminal colliculus. On the surface of the colliculus there are 3 openings: one for the prostatic utricle (in the middle) and 2 for the ejaculatory ducts (one on each side of that of the utricle). On each side of the urethral crest

there is a longitudinal depression termed prostatic sinus which receives the orifices of the prostatic ducts.



1. neck of the bladder surrounded by the sphincter vesicae.
2. base of the prostate.
3. seminal colliculus (a rounded elevation on the middle of the urethral crest).
4. openings of the 2 ejaculatory ducts (on the surface of the colliculus).
5. urethral crest (a longitudinal elevation in the middle of the posterior wall).
6. openings of prostatic ducts into the prostatic sinus.
7. opening of the prostatic utricle (between those of the ejaculatory ducts).
8. levator ani.
9. apex of the prostate.

Fig.(416): PROSTATIC URETHRA (T.S.)
(at the level of the seminal colliculus)

1. prostatic urethra (T.S.).
2. glandular tissue of the prostate.
3. ejaculatory duct.
4. prostatic utricle.
5. median lobe of the prostate (between the 2 ejaculatory ducts).
6. lateral lobe of the prostate.
7. prostatic sinus (receives the openings of the prostatic ducts).

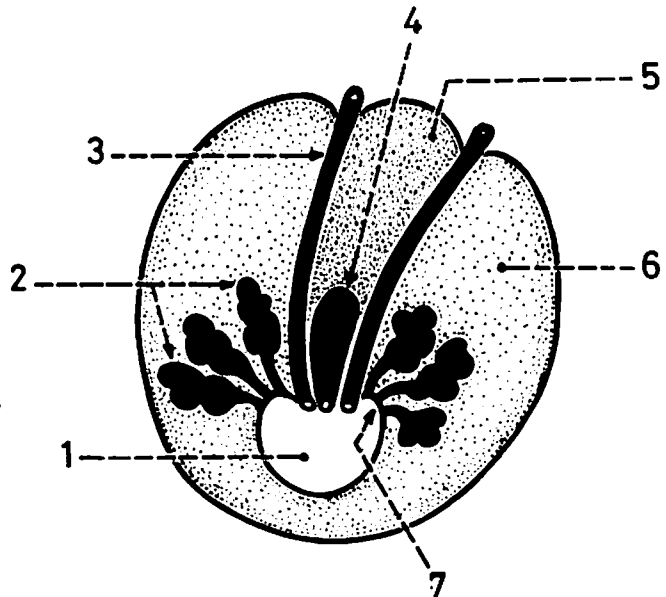
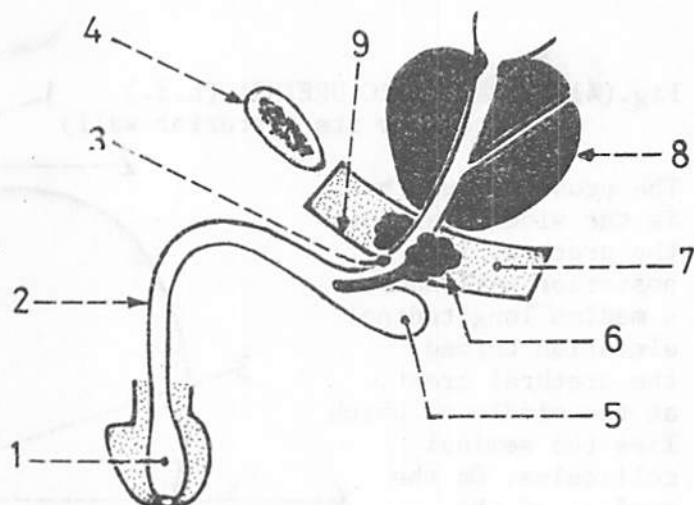


Fig.(417): MEMBRANOUS AND SPONGY PARTS OF THE MALE URETHRA

The membranous urethra extends from the prostate to the bulb of the penis. It perforates the perineal membrane in company with the ducts of the bulbo-urethral glands (one on each side). It then pierces the bulb of the penis to join the spongy urethra just in front of the intrabulbar fossa. The spongy urethra extends through the whole length of the corpus spongiosum with its posterior end dilated forming the intrabulbar fossa and its anterior end dilated forming the navicular fossa.



1. navicular fossa.
2. spongy urethra.
3. membranous urethra.
4. symphysis pubis.
5. intrabulbar fossa (in the bulb of the penis).
6. bulbo-urethral gland.
7. deep perineal pouch.
8. prostate.
9. perineal membrane.

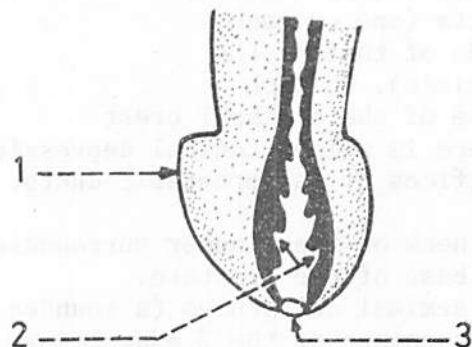


Fig.(418): NAVICULAR FOSSA

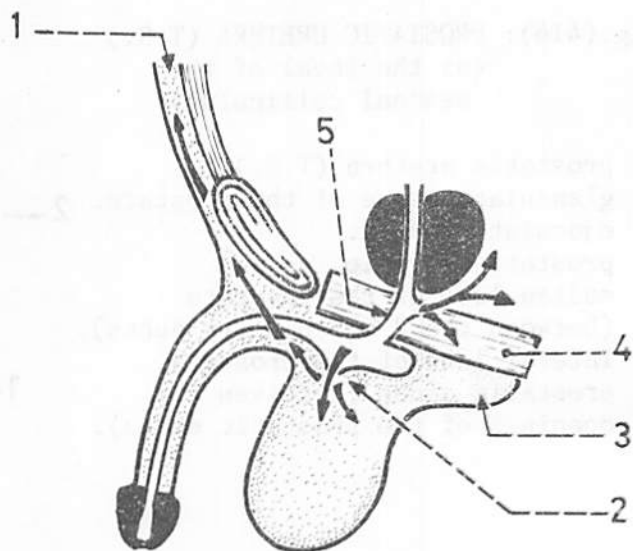
It is the dilated terminal part of the spongy urethra within the glans penis.

1. glans penis.
2. lacunae with their orifices directed forwards.
3. external urethral orifice.

Fig.(419): RUPTURE OF URETHRA

Rupture of the spongy urethra leads to extravasation of urine into the superficial perineal pouch, while rupture of the membranous urethra leads to collection of urine in the deep perineal pouch and pelvic cavity.

1. anterior abdominal wall.
2. rupture of spongy urethra.
3. superficial perineal pouch.
4. deep perineal pouch.
5. rupture of membranous urethra.



RECTUM AND ANAL CANAL

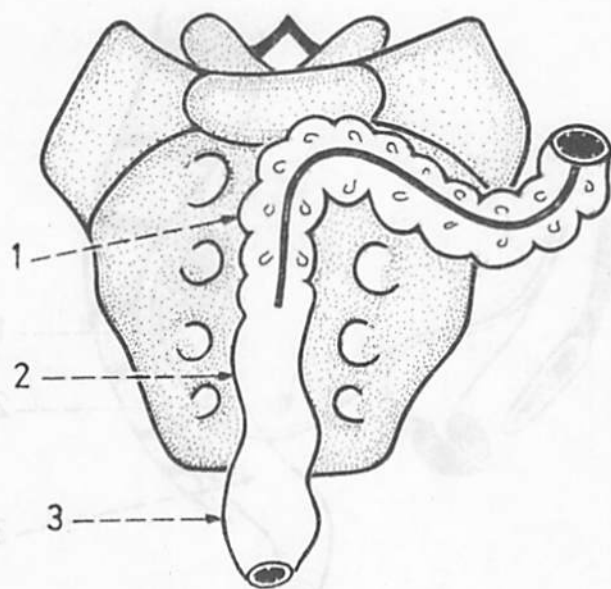


Fig.(420): POSITION OF THE RECTUM

The rectum begins at the 3rd sacral vertebra as the continuation of the sigmoid colon and ends at 2-3 cm below the tip of the coccyx where it continues as the anal canal.

1. sigmoid colon.
2. rectum (devoid of appendices epiploicae, sacculations and taeniae coli).
3. ampulla of the rectum (lower dilated part of the rectum).

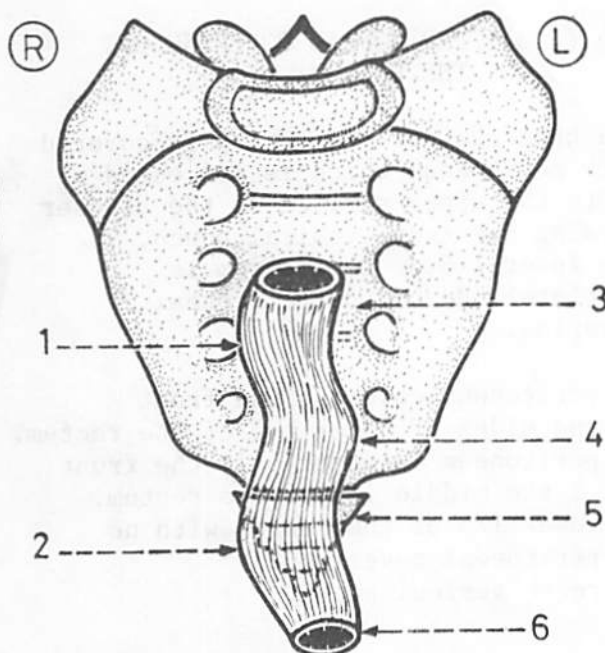


Fig.(421): LATERAL CURVES OF THE RECTUM

The rectum has 3 side curves: upper, middle and lower.

1. upper curve (convex to the right).
2. lower curve (convex to the right).
3. beginning of the rectum (at 3rd S.V.).
4. middle curve (convex to the left).
5. coccyx.
6. end of the rectum (2-3 cm below and in front of the tip of coccyx).

Fig.(422): ANTEROPOSTERIOR CURVES OF THE RECTUM

The rectum has an upper curve concave forwards following the curve of the sacrum and coccyx (sacral flexure), and a lower curve at the ano-rectal junction which is concave backwards (perineal flexure).

1. sacral flexure (concave forwards).
2. sacrum.
3. tip of coccyx.
4. puborectalis curving around the ano-rectal junction in the perineal flexure.
5. anal canal directed downwards and backwards.

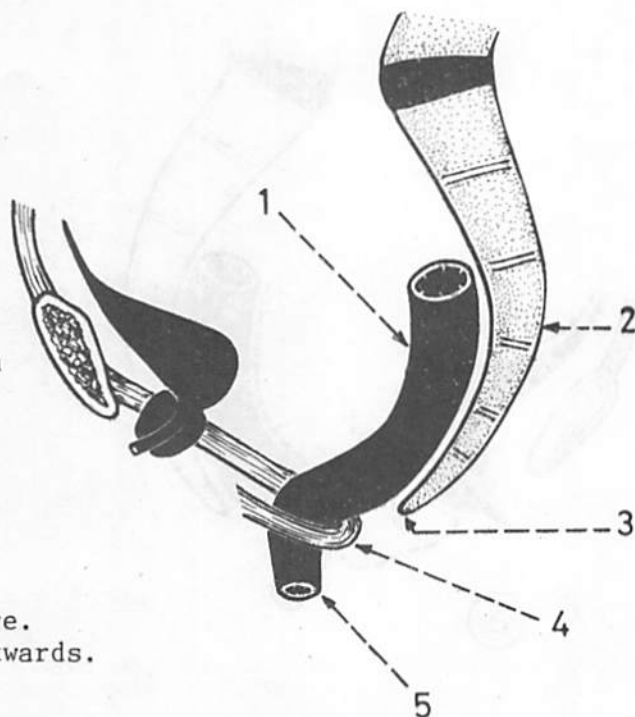


Fig.(423): PERITONEAL COVERING OF THE RECTUM

The upper 2/3 of the rectum is covered with peritoneum which is reflected on to the upper surface of the bladder forming the recto-vesical pouch. The lower 1/3 of the rectum is completely devoid of peritoneal covering.

1. peritoneum covering the front and sides of upper 1/3 of the rectum.
2. peritoneum covering only the front of the middle 1/3 of the rectum.
3. lower 1/3 of the rectum with no peritoneal covering.
4. recto-vesical pouch.

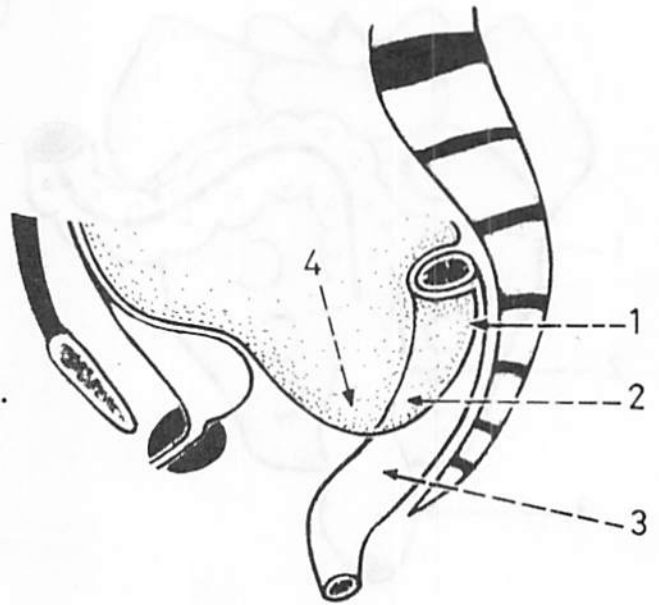


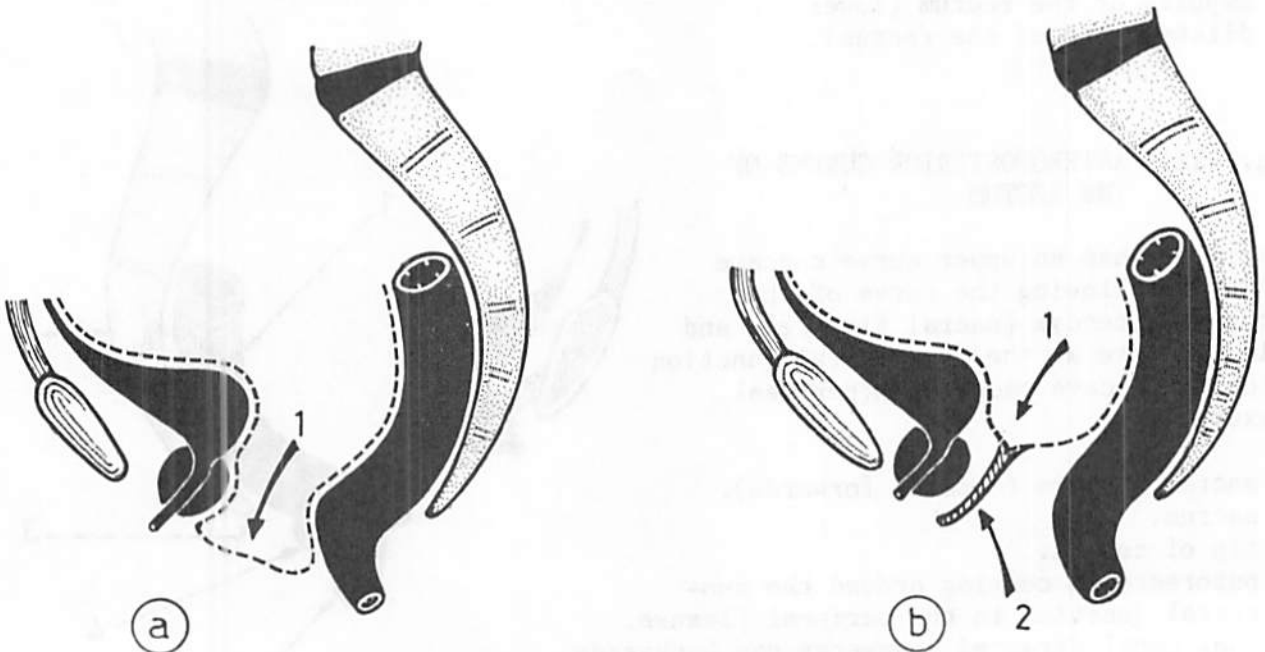
Fig.(424): FORMATION OF THE RECTO-VESICAL POUCH

(a) In the foetus.

(b) After birth.

In the foetus, the peritoneum covers the lower 1/3 of the rectum from which it is reflected on the back of the prostate and base of the bladder forming a deep recto-vesical pouch. However, after birth the peritoneum on the lower 1/3 of rectum fuses with that on the prostate and base of the bladder forming a septum of fibrous tissue and obliterating the lower part of the recto-vesical pouch.

1. recto-vesical pouch.
2. recto-vesical septum.



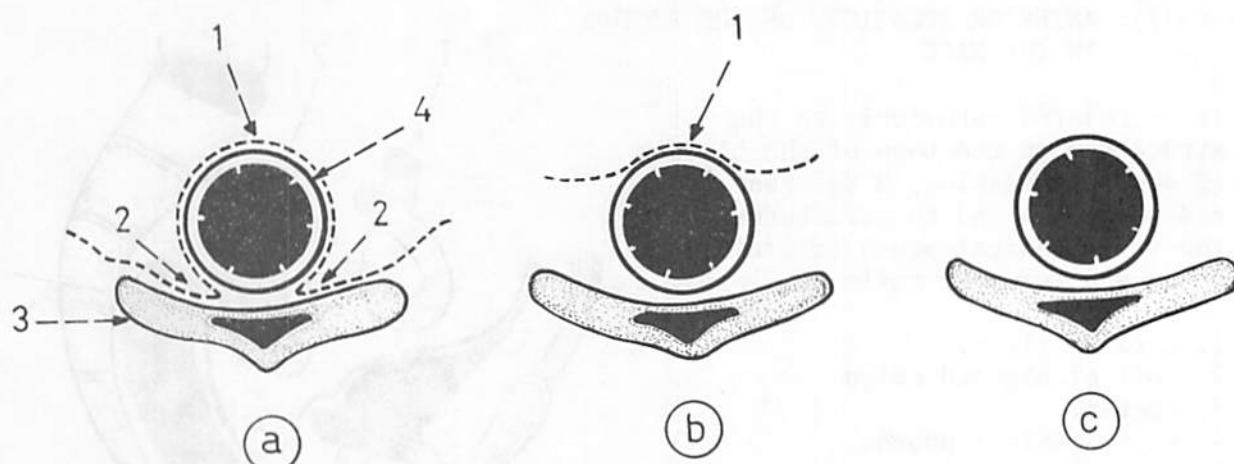


Fig.(425): PERITONEAL RELATIONS OF THE RECTUM (T.S.)

- (a) Upper 1/3: the peritoneum covers the front and sides of the rectum.
 1. peritoneum on the front of the rectum; 2. peritoneum forming pararectal fossa; 3. sacrum; 4. rectum.
- (b) Middle 1/3: the peritoneum covers the front of the rectum only.
 1. peritoneum covering the front of the rectum.
- (c) Lower 1/3: the rectum is devoid of peritoneal covering.

Fig.(426): POSTERIOR RELATIONS OF THE RECTUM

These are: bones (lower 3 sacral vertebrae and the coccyx), muscles (piriformis, coccygeus and levator ani), vessels (median sacral, lower lateral sacral and superior rectal) and nerves (ventral rami of lower 3 sacral nerves and the 2 sympathetic trunks).

1. sympathetic trunk.
2. ventral rami of sacral plexus.
3. median sacral artery.
4. lateral sacral arteries.
5. piriformis.
6. coccygeus.
7. levator ani.
8. ano-coccygeal raphe.
9. coccyx.

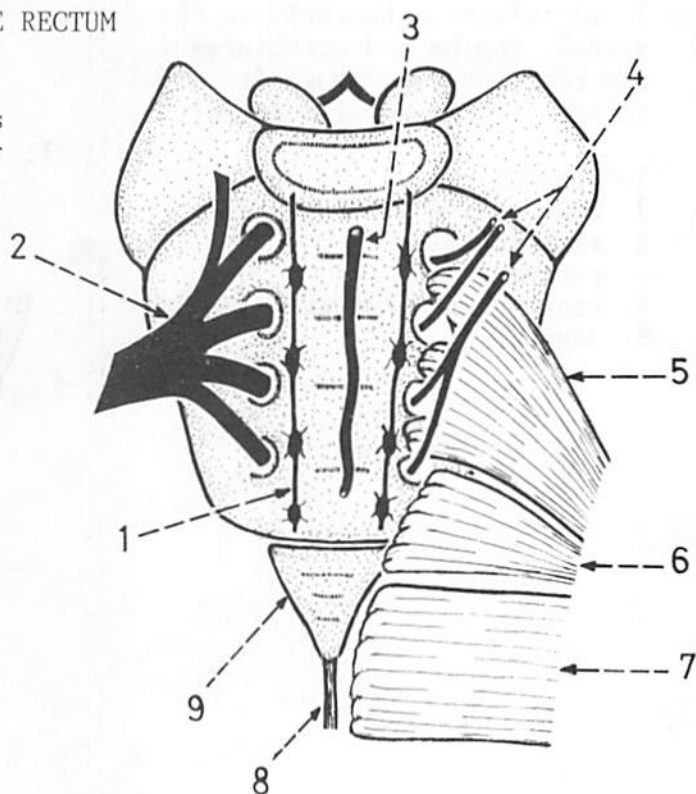


Fig.(427): ANTERIOR RELATIONS OF THE RECTUM
IN THE MALE

It is related anteriorly to the structures on the base of the bladder (2 seminal vesicles, 2 deferent ducts and prostate) and to structures in the recto-vesical pouch (sigmoid colon and terminal coils of ileum).

1. coil of ileum.
2. coil of sigmoid colon.
3. rectum.
4. recto-vesical pouch.
5. seminal vesicle.
6. prostate.

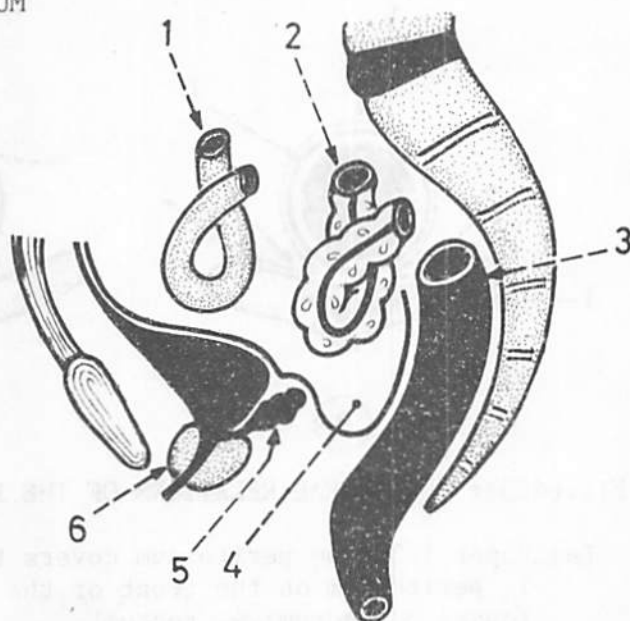
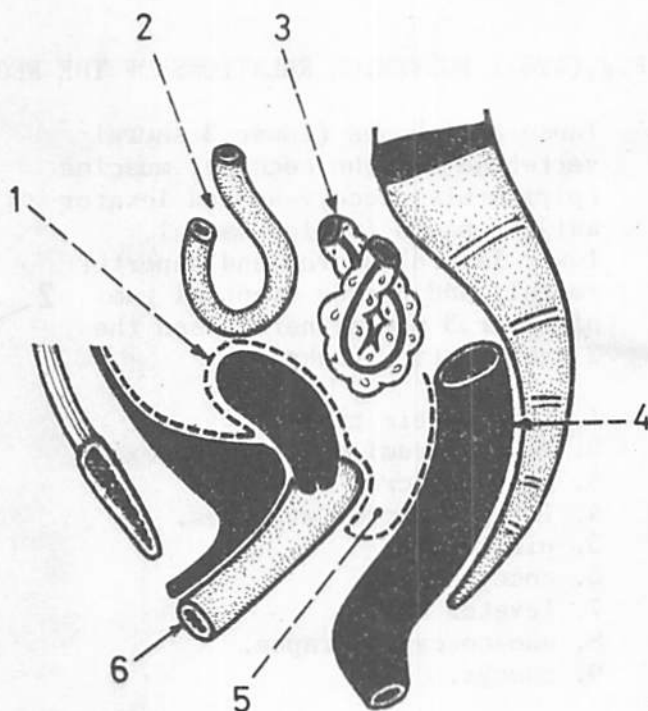


Fig.(428): ANTERIOR RELATIONS OF THE RECTUM
IN THE FEMALE

It is related anteriorly to the uterus, vagina and structures in the recto-uterine pouch (terminal coils of ileum and sigmoid colon).

1. uterus.
2. coil of ileum.
3. sigmoid colon.
4. rectum.
5. recto-uterine pouch.
6. vagina.



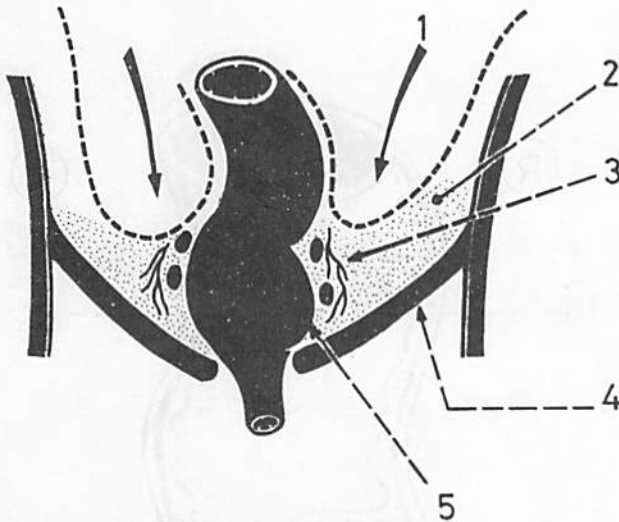


Fig.(429): LATERAL RELATIONS OF THE RECTUM

These are: pararectal fossa, inferior hypogastric plexus, pararectal nodes and levator ani (on each side).

1. pararectal fossa.
2. pelvic fascia.
3. inferior hypogastric plexus and pararectal lymph nodes.
4. levator ani.
5. rectum.

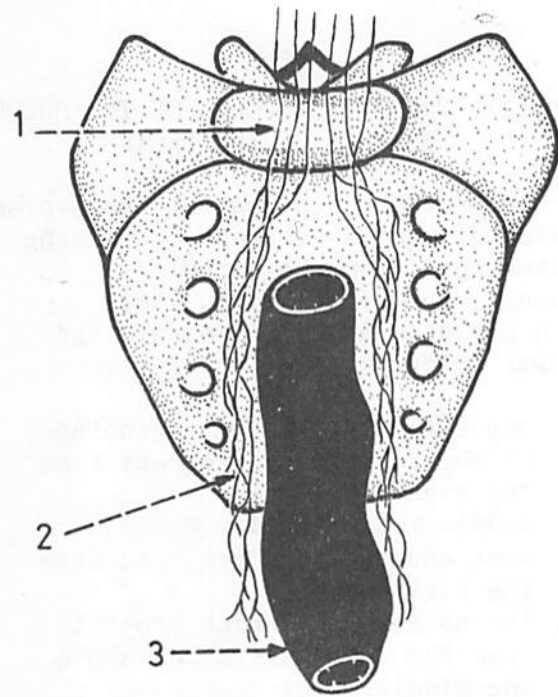


Fig.(430): RELATION OF THE RECTUM TO INFERIOR HYPOGASTRIC PLEXUSES

The right and left hypogastric plexuses descend one on each side of the rectum.

1. superior hypogastric plexus.
2. right inferior hypogastric plexus.
3. rectum.

Fig.(431): EXAMINATION PER RECTUM (P-R) IN THE MALE

With the index finger inserted into the rectum through the anal canal the following structures can be felt anteriorly: bulb of the penis, prostate, seminal vesicles and lower part of the base of the bladder just above the prostate.

1. bulb of the penis.
2. prostate.
3. seminal vesicle.
4. finger inserted into the rectum.

* In the female the cervix of the uterus and abnormal contents of the rectouterine pouch can be felt by P-R examination.

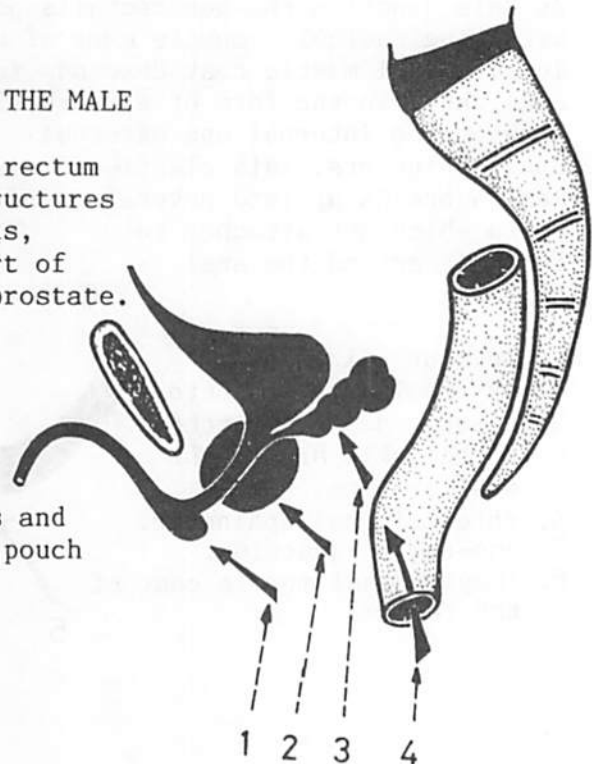


Fig.(432): TRANSVERSE FOLDS OF THE MUCOUS MEMBRANE OF THE RECTUM

These are 3 or 4 permanent transverse folds of mucous membrane containing extensions from the circular muscle coat of the wall. They are arranged as upper, middle and lower folds.

1. upper fold: near the beginning of the rectum and projects from the right wall.
2. middle fold: the largest and most constant and projects from the right wall.
3. inconstant fold which projects from the left wall $2\frac{1}{2}$ cm above the middle fold.
4. lowest fold: it is also inconstant and projects from the left wall $2\frac{1}{2}$ cm below the middle fold.
5. circular muscle coat of the rectum.

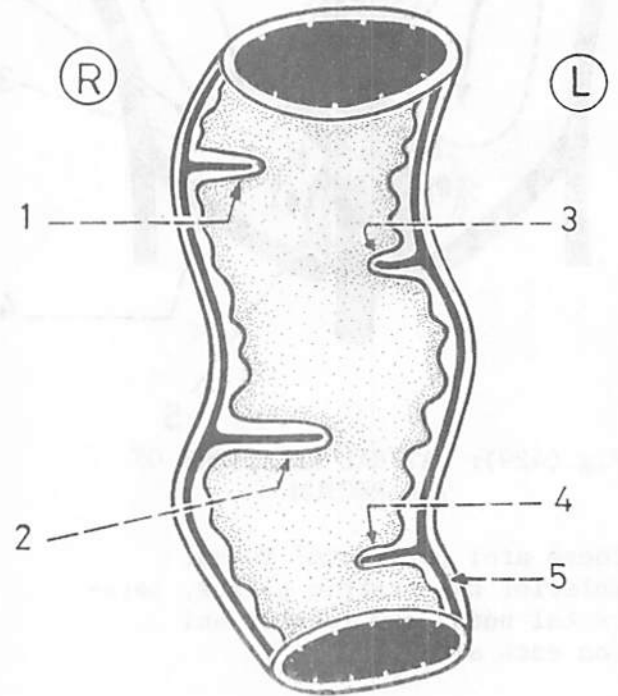


Fig.(433): ANO-RECTAL JUNCTION

At this junction the puborectalis part of levator ani blends with longitudinal muscle coat of the rectum. This longitudinal muscle coat descends in the wall of the anal canal in the form of a fibro-elastic lamina between the internal and external anal sphincters. This elastic lamina breaks up into several septa which get attached to the skin around the anal orifice.

1. levator ani muscle.
2. external anal sphincter.
3. elastic septa attached to the skin around the anal orifice.
4. internal anal sphincter.
5. ano-rectal junction.
6. longitudinal muscle coat of the rectum.

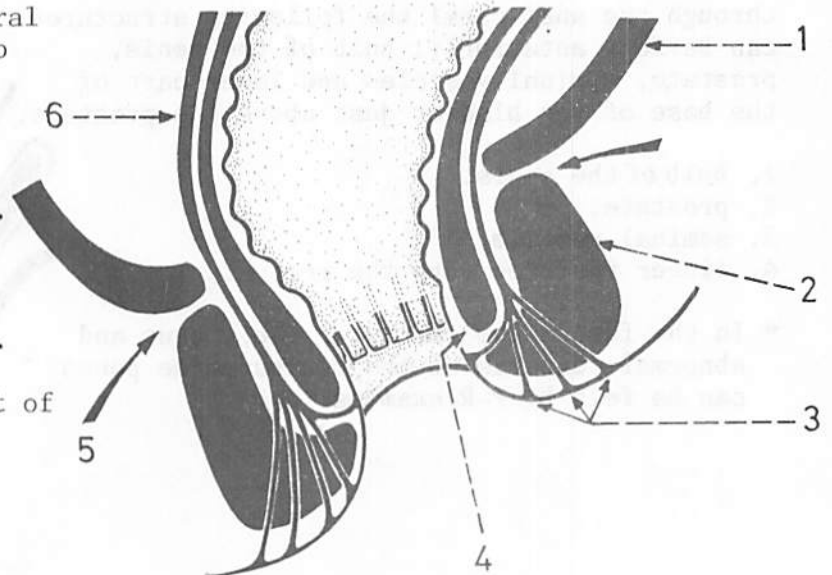


Fig.(434): POSITION AND RELATIONS OF THE ANAL CANAL
IN THE MALE

The anal canal begins 2-3 cm below and in front of the tip of the coccyx and passes downwards and backwards for 4 cm to end at the anal orifice. It is related behind to the ano-coccygeal raphe (ligament) and in front to the perineal body which separates it from the bulb of the penis.

1. bulb of the penis.
2. perineal body (fibromuscular mass).
3. anal canal.
4. ano-coccygeal raphe (ligament).
5. tip of the coccyx.

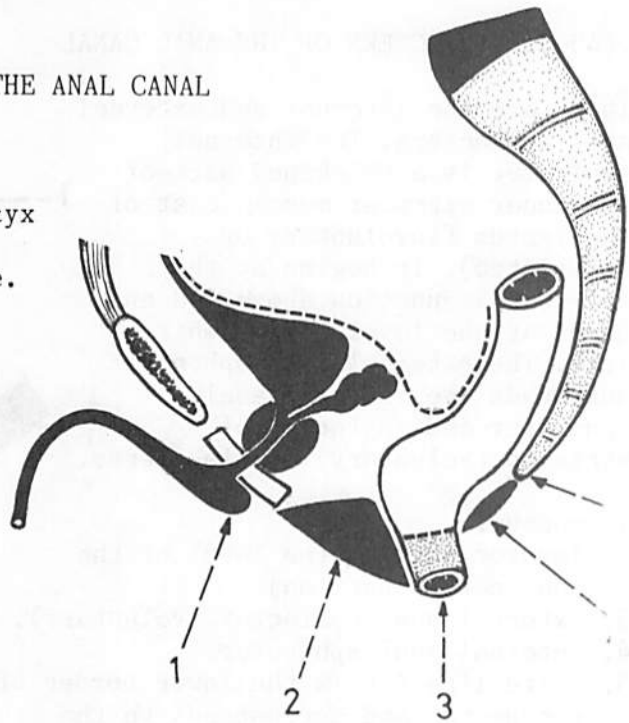


Fig.(435): POSITION AND RELATIONS OF THE ANAL CANAL
IN THE FEMALE

The anal canal has the same position and relations as in the male except that the perineal body separates it from the vagina.

1. vagina.
2. perineal body.
3. anal canal.
4. ano-coccygeal raphe (ligament).
5. tip of the coccyx.
6. rectum.

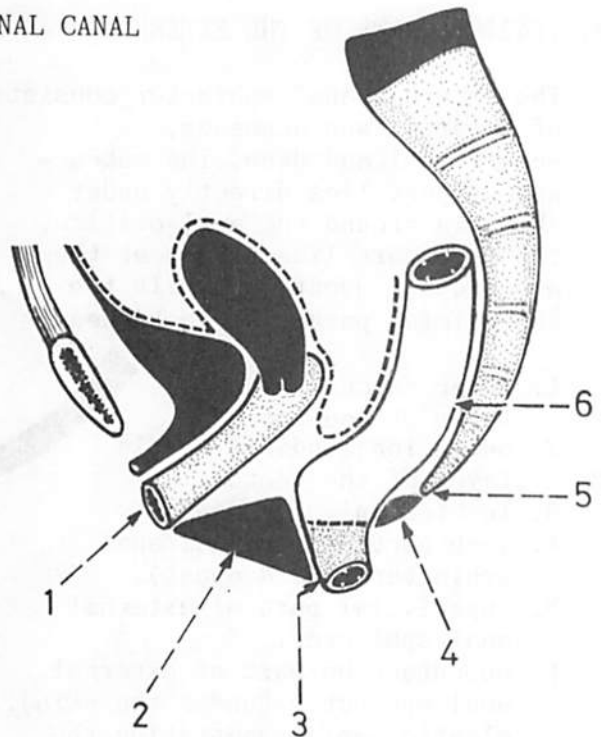


Fig.(436): SPHINCTERS OF THE ANAL CANAL

These are the internal and external anal sphincters. The internal anal sphincter is a thickened part of the inner circular muscle coat of the rectum (involuntary or unstriated). It begins at the ano-rectal junction above and ends below at the level of the white line. The external anal sphincter surrounds the internal anal sphincter and is formed of striated (voluntary) muscle fibres.

1. rectum.
2. levator ani (at the level of the ano-rectal junction).
3. external anal sphincter (voluntary).
4. internal anal sphincter.
5. white line (it is the lower border of the pecten and corresponds to the lower edge of the internal anal sphincter).
6. pectinate line (the line of the anal valves).

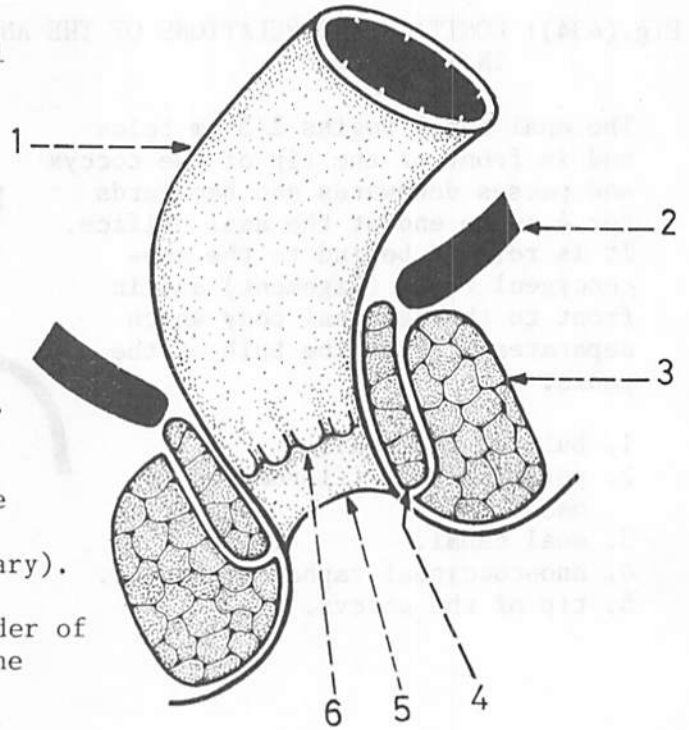
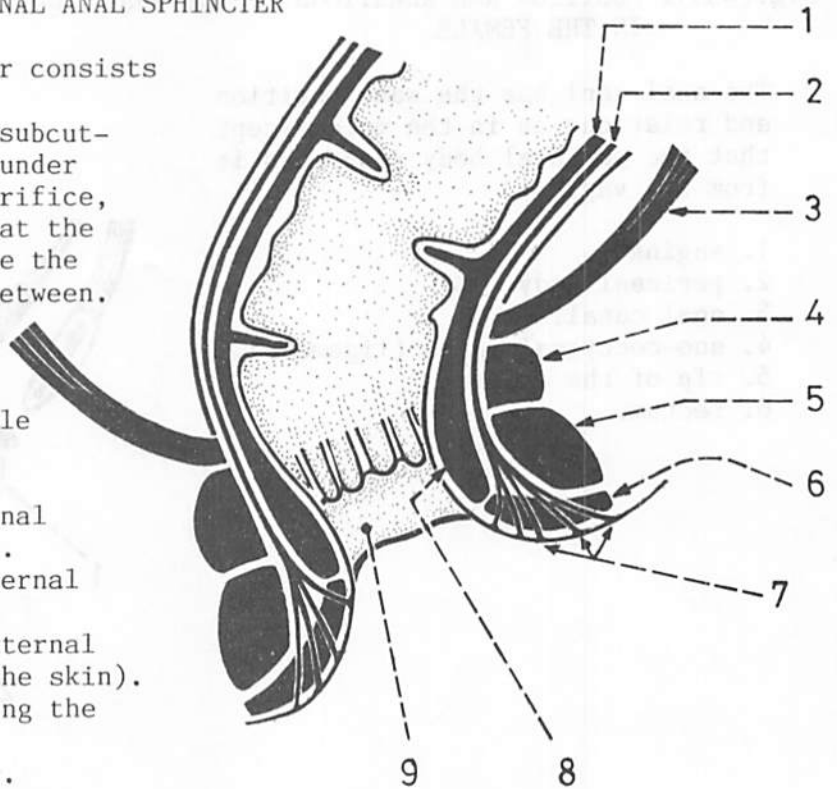


Fig.(437): PARTS OF THE EXTERNAL ANAL SPHINCTER

The external anal sphincter consists of 3 parts: subcutaneous, superficial and deep. The subcutaneous part lies directly under the skin around the anal orifice, the deep part lies deeply at the ano-rectal junction, while the superficial part lies in between.

1. inner circular muscle layer of the rectum.
2. outer longitudinal muscle layer of the rectum.
3. levator ani.
4. deep part of external anal sphincter (the deepest).
5. superficial part of external anal sphincter.
6. subcutaneous part of external anal sphincter (under the skin).
7. elastic septa penetrating the subcutaneous part.
8. internal anal sphincter.
9. pecten of anal canal.



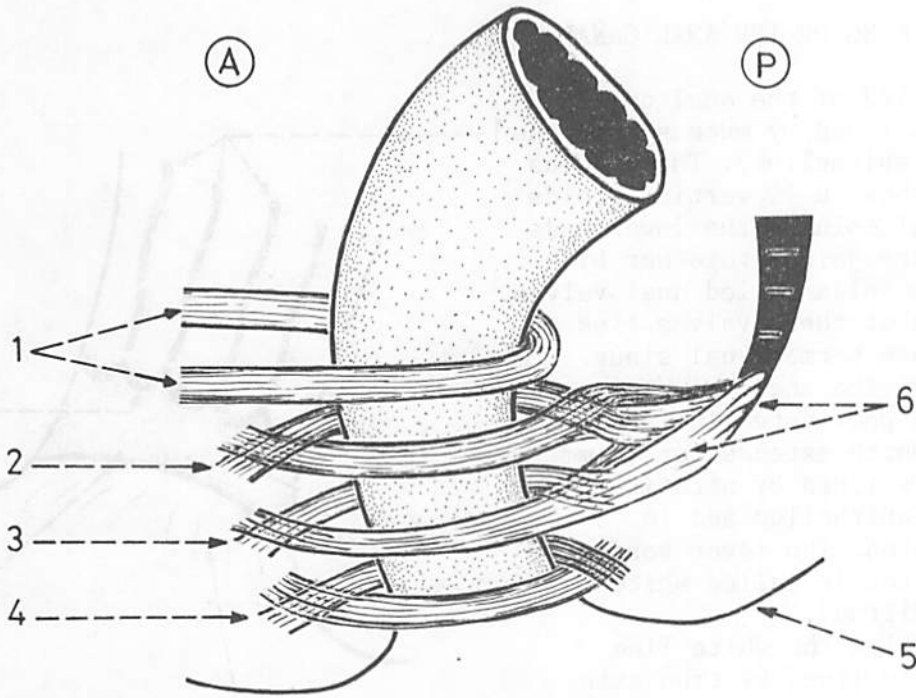


Fig.(438): ARRANGEMENT OF THE FIBRES OF THE EXTERNAL ANAL SPHINCTER

1. pubo-rectalis: a sling-like part of the levator ani curving behind the rectum at the ano-rectal junction (acts as an additional sphincter).
2. deep part of external anal sphincter: lies above the superficial part.
3. superficial part of external anal sphincter.
4. subcutaneous part of external anal sphincter (the lowermost part).
5. skin around the anal orifice.
6. coccyx and ano-coccygeal ligament.

Fig.(439): NERVE SUPPLY OF THE ANAL SPHINCTERS

The external sphincter is supplied by somatic nerves, viz. inferior rectal nerve and perineal branch of the 4th sacral nerve. The internal sphincter, however, is supplied by parasympathetic fibres derived from the pelvic splanchnic nerve (S.2,3,4).

1. autonomic fibres on the side of the rectum.
2. inferior rectal nerve.
3. perineal branch of the 4th sacral nerve.
4. external anal sphincter.
5. internal anal sphincter.

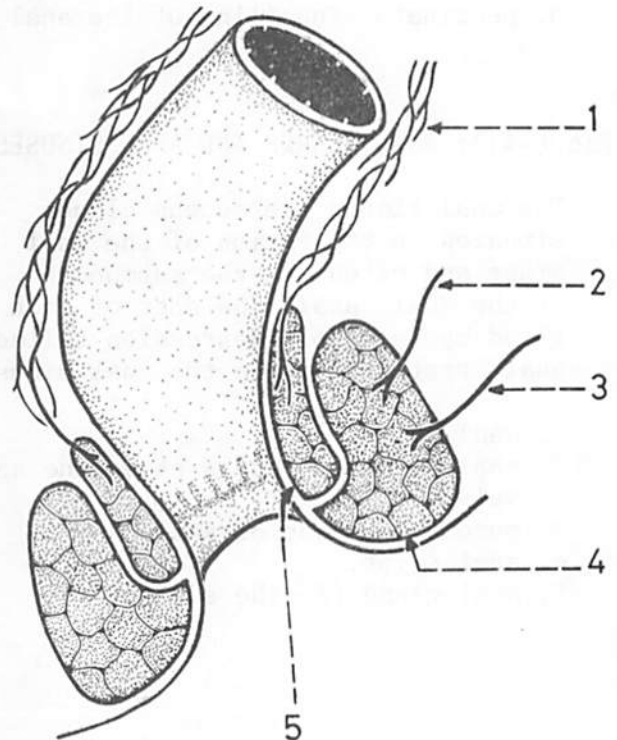
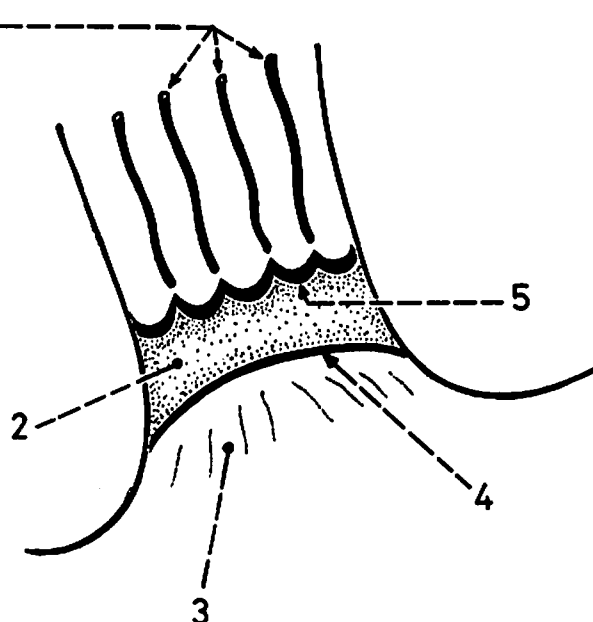


Fig.(440): LINING OF THE ANAL CANAL

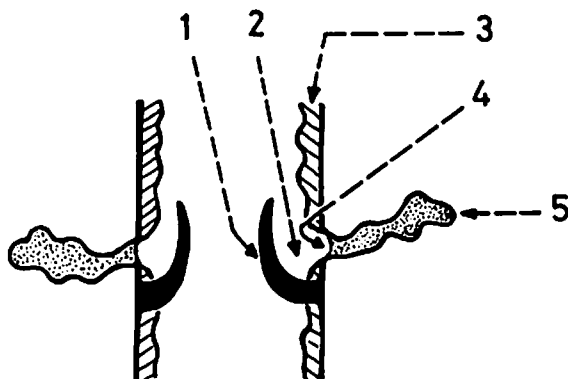
The upper 1/2 of the anal canal (15 mm) is lined by mucous membrane (columnar epithelium). This mucous membrane shows 6-10 vertical folds called anal columns the lower ends of which are joined together by valve-like folds called anal valves. Above each of these valves lies a small recess termed anal sinus. The line of the anal valves is termed the pectinate line, and the area which extends for 15 mm below it is lined by stratified squamous epithelium and is called pecten. The lower border of the pecten is called white line (of Hilton). The area below the white line (5-10 mm) is lined by true skin with sweat and sebaceous glands.



1. anal columns (each column overlies a branch of the superior rectal artery).
2. pecten (the area of stratified squamous epithelium).
3. lowermost part of anal canal (lined by true skin).
4. white line (lower border of the pecten).
5. pectinate line (line of the anal valve).

Fig.(441): ANAL GLANDS AND ANAL SINUSES

The anal glands are mucous glands situated in the region of the anal sinus and extend in the submucosa of the anal canal. The duct of each gland opens into a depression called anal crypt present in the anal sinus.



1. anal valve.
2. anal sinus (a recess above the anal valve).
3. mucous membrane of anal canal.
4. anal crypt.
5. anal gland (in the submucosa).

Fig.(442): RECTAL VENOUS PLEXUSES

The submucosa of the anal canal and lower part of the rectum lodges 2 venous plexuses: internal rectal plexus (above the white line) and external rectal plexus (below the white line underneath the skin which lines the lower part of the anal canal). The subcutaneous space in which the external rectal plexus lies is called the perianal space.

1. internal rectal plexus (above the white line).
2. levator ani.
3. anal sphincter.
4. external rectal plexus (below the white line).
5. white line.
6. perianal space (subcutaneous space in the lower part of the anal canal which is lined by skin).

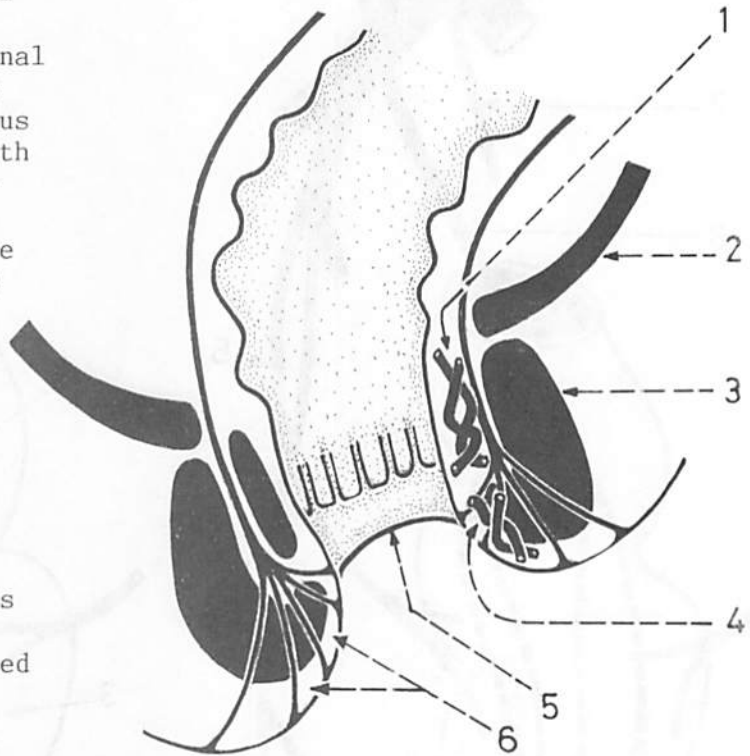
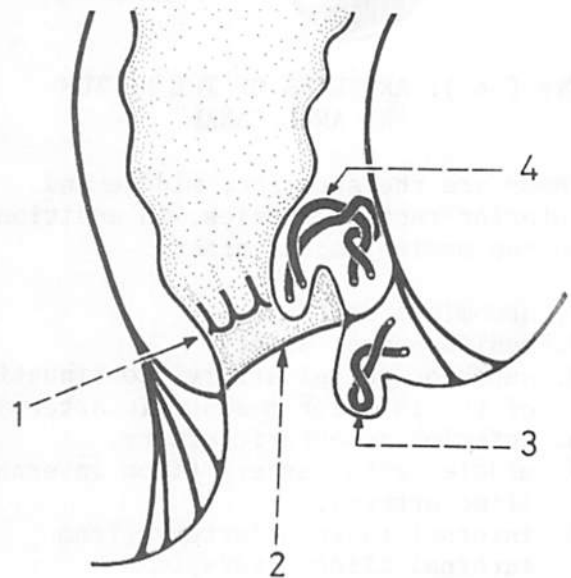


Fig.(443): PILES (HAEMORRHOIDS)

There are 2 types of piles: internal piles which result from dilatation of the internal rectal plexus, and external piles which result from dilatation from the external rectal plexus. The internal piles project above the white line and are covered by mucous membrane, while the external piles project below the white line and are covered by true skin.

1. upper part of anal canal lined by mucous membrane.
2. white line.
3. external piles (in the perianal space).
4. internal piles (above the white line).



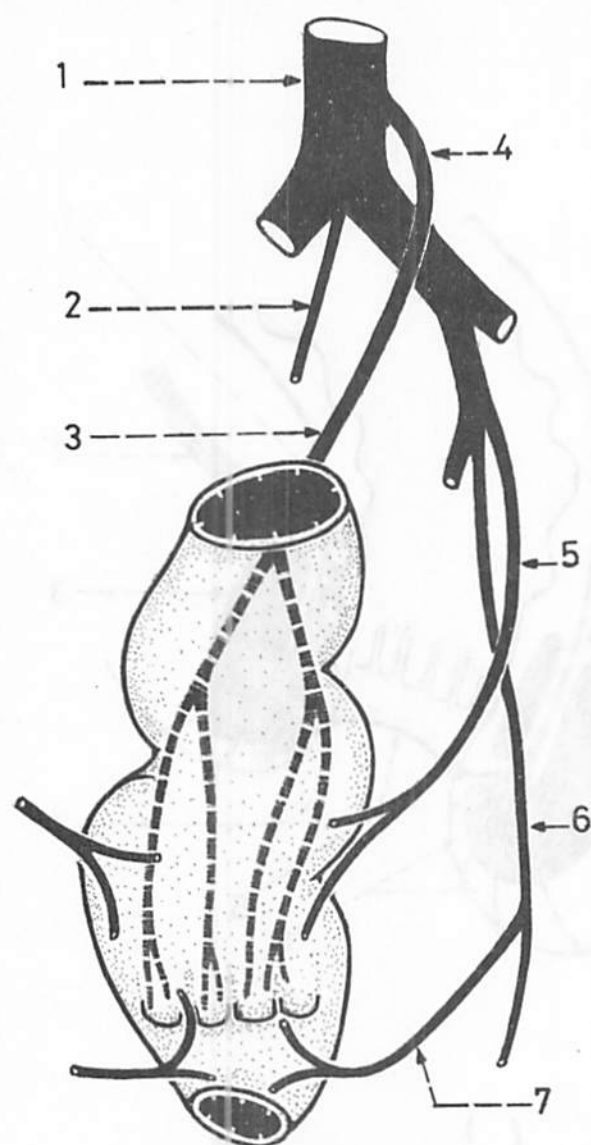


Fig.(444): ARTERIES OF THE RECTUM AND ANAL CANAL

These are the superior, middle and inferior rectal arteries, in addition to the median sacral artery.

1. abdominal aorta.
2. median sacral artery.
3. superior rectal artery (continuation of the inferior mesenteric artery).
4. inferior mesenteric artery.
5. middle rectal artery (from internal iliac artery).
6. internal pudendal artery (from internal iliac artery).
7. inferior rectal artery (from internal pudendal artery).

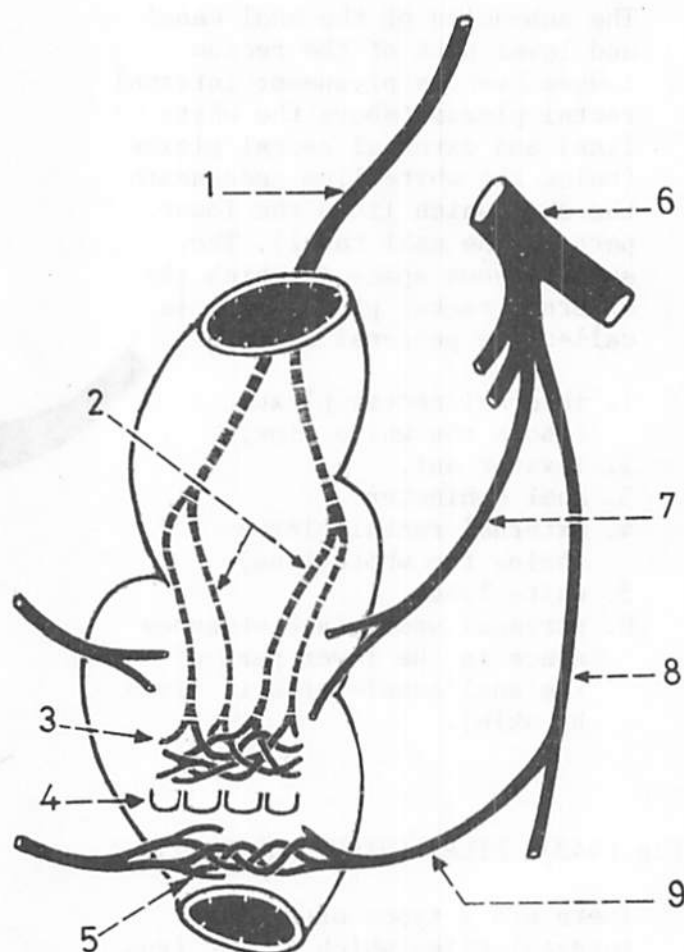
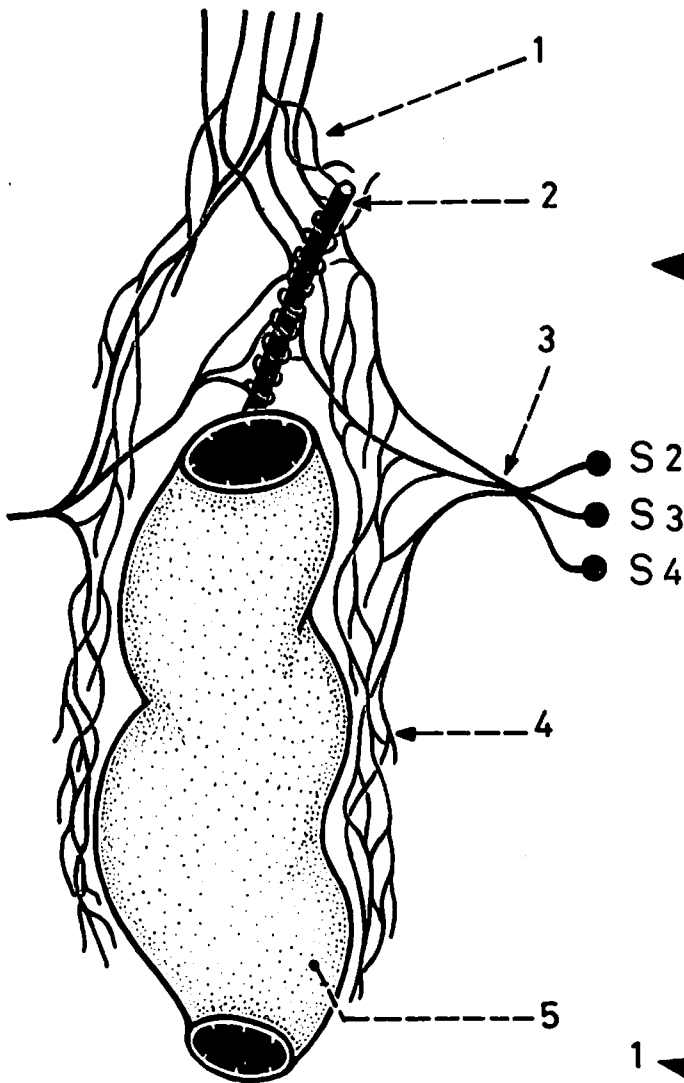


Fig.(445): VEINS OF THE RECTUM AND ANAL CANAL

These are the superior, middle and inferior rectal veins. They anastomose together in the submucosa of the anal canal and lower part of the rectum.

1. superior rectal vein (portal).
2. tributaries of superior rectal vein.
3. internal rectal venous plexus.
4. anal valves.
5. external rectal venous plexus.
6. common iliac vein.
7. middle rectal vein (systemic).
8. internal pudendal vein.
9. inferior rectal vein (systemic).

Fig.(446): NERVES OF THE RECTUM AND ANAL CANAL



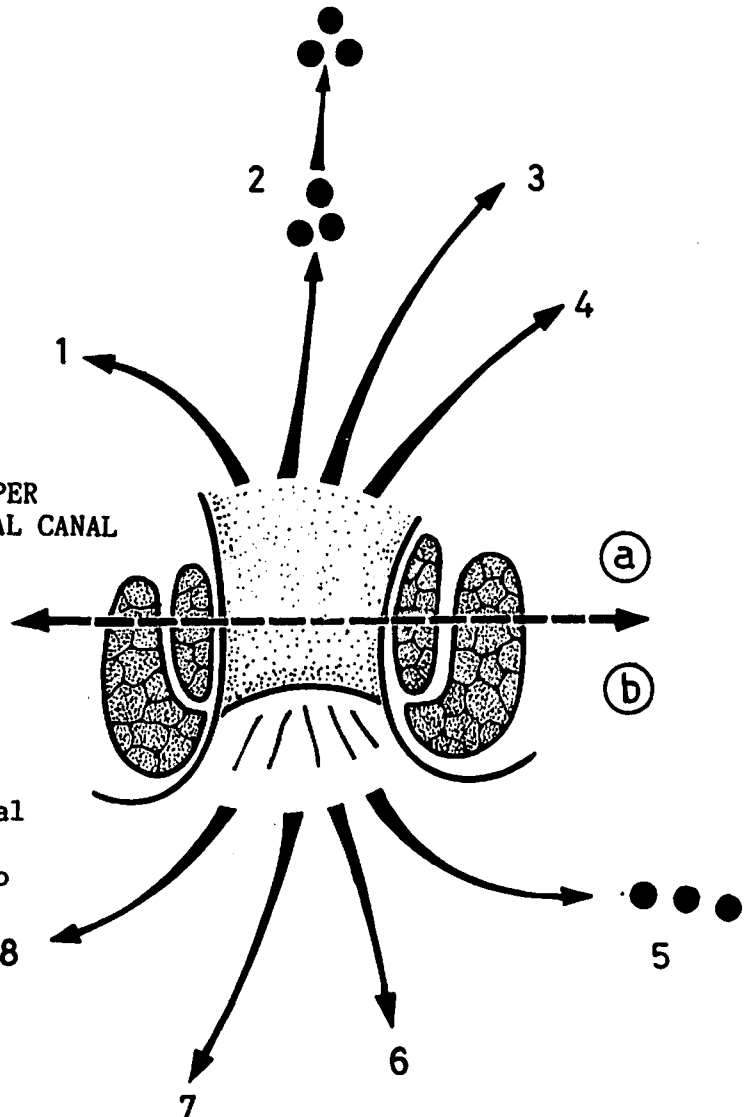
The rectum and anal canal are supplied by sympathetic fibres through the inferior hypogastric plexuses which descend one on each side of the rectum. They also get parasympathetic fibres from the pelvic splanchnic nerves (S.2,3,4).

1. superior hypogastric plexus.
2. superior rectal artery.
3. pelvic splanchnic nerve.
4. left inferior hypogastric plexus.
5. ampulla of the rectum.

Fig.(447): DIFFERENCES BETWEEN UPPER AND LOWER HALVES OF ANAL CANAL

(a) upper half: endodermal in origin (1), drains into internal iliac nodes (2), supplied by sympathetic nerves (3) and drains into the portal system(4).

(b) lower half: ectodermal in origin (8), drains into superficial inguinal nodes (5), supplied by somatic nerves (6) and drains into the systemic circulation (7).



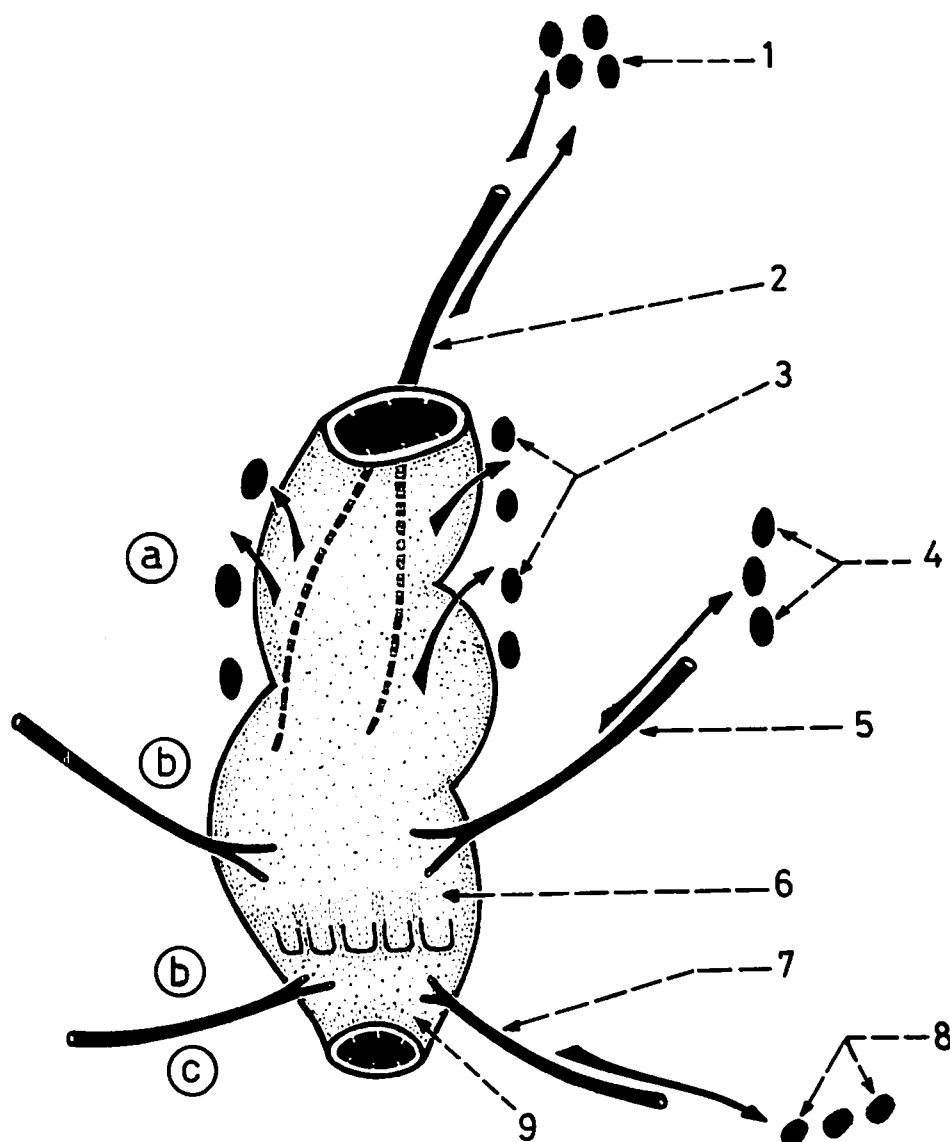


Fig.(448): LYMPHATIC DRAINAGE OF THE RECTUM AND ANAL CANAL

- (a) Upper half of the rectum: the lymph vessels ascend along the superior rectal vessels to end in the pararectal nodes and the nodes around the origin of the inferior mesenteric artery.
- (b) Lower half of the rectum and upper half of the anal canal: the lymph vessels run along the middle rectal vessels to end in the internal iliac nodes.
- (c) Lower half of the anal canal (below the white line): the lymph vessels descend towards the anal orifice and then pass laterally to end in the superficial inguinal nodes.

- 1. inferior mesenteric nodes.
- 2. superior rectal artery.
- 3. pararectal nodes (on each side of the rectum).
- 4. internal iliac nodes.

- 5. middle rectal artery.
- 6. upper half of anal canal.
- 7. inferior rectal artery.
- 8. superficial inguinal nodes.
- 9. lower half of anal canal.

MALE GENITAL ORGANS

Fig.(449): COURSE OF THE DUCTUS (VAS) DEFERENS

The ductus deferens runs its course in 3 regions: the scrotum, inguinal canal and pelvic cavity. It begins as the continuation of the tail of epididymis and ascends in the posterior part of the spermatic cord as far as the deep inguinal ring. At the deep inguinal ring it curves lateral to the inferior epigastric artery and then runs downwards and backwards on the lateral wall of the lesser pelvis to reach the base of the bladder. Here, it crosses in front of the termination of the ureter and then expands to form the ampulla of the ductus deferens. It joins the duct of the seminal vesicle to form the ejaculatory duct.

1. ductus deferens in the pelvis.
2. external iliac artery.
3. inferior epigastric artery.
4. ductus deferens in the scrotum.
5. tail of epididymis.
6. pelvic ureter.
7. ampulla of ductus deferens.

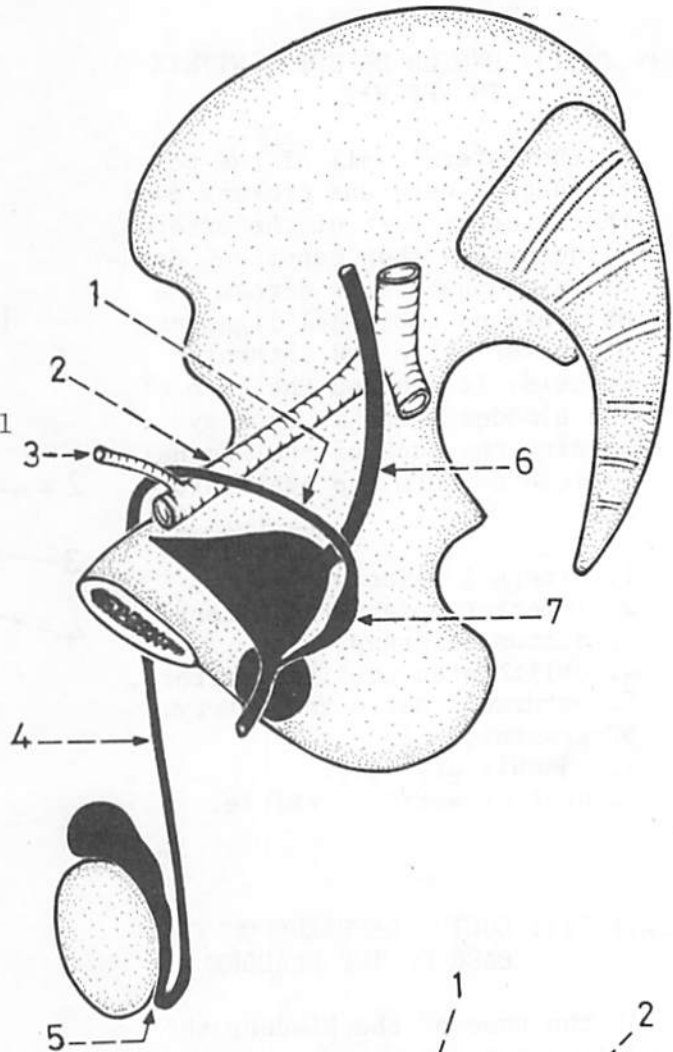


Fig.(450): COURSE OF DUCTUS DEFERENS OUTSIDE THE PELVIS

At its beginning the ductus deferens lies on the posterior border of the testis, medial to the epididymis. It is the main constituent of the spermatic cord in which it ascends as far as the deep inguinal ring.

1. inferior epigastric artery.
2. ductus deferens curving round the lateral side of the inferior epigastric artery.
3. ductus deferens in the inguinal canal.
4. ductus deferens in the scrotum.
5. tail of epididymis.

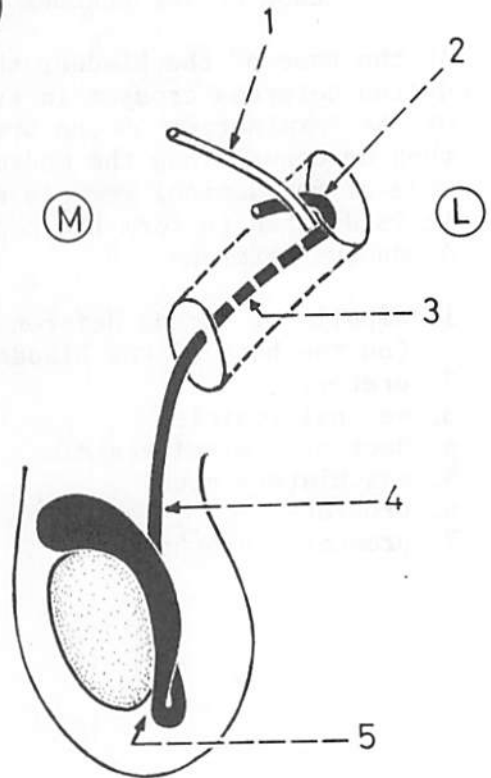


Fig.(451): DUCTUS DEFERENS WITHIN THE PELVIS

On the lateral wall of the pelvis, the ductus deferens crosses over the anterior part of the external iliac artery then continues downwards and backwards across the obliterated umbilical ligament, obturator nerve and obturator vessels. It reaches the base of the bladder where it ends by joining the duct of the seminal vesicle to form the ejaculatory duct.

1. external iliac artery.
2. inferior epigastric artery.
3. ductus deferens.
4. obliterated umbilical artery.
5. obturator nerve and artery.
6. prostate.
7. ejaculatory duct.
8. duct of seminal vesicle.

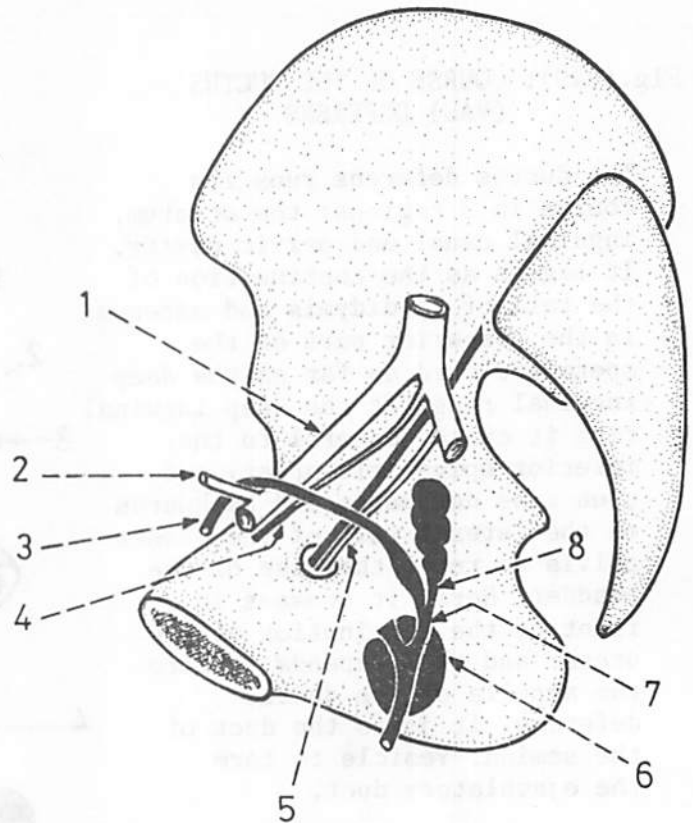
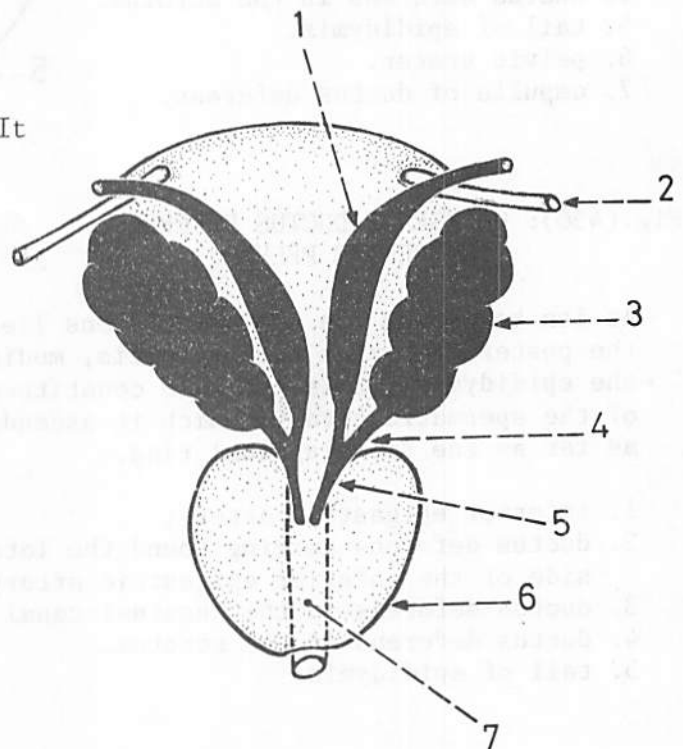


Fig.(452): DUCTUS DEFERENS ON THE BASE OF THE BLADDER

At the base of the bladder the ductus deferens crosses in front of the termination of the ureter. It then descends along the medial side of the seminal vesicle where it is dilated to form the ampulla of ductus deferens.

1. ampulla of ductus deferens (on the base of the bladder).
2. ureter.
3. seminal vesicle.
4. duct of seminal vesicle.
5. ejaculatory duct.
6. prostate.
7. prostatic urethra.



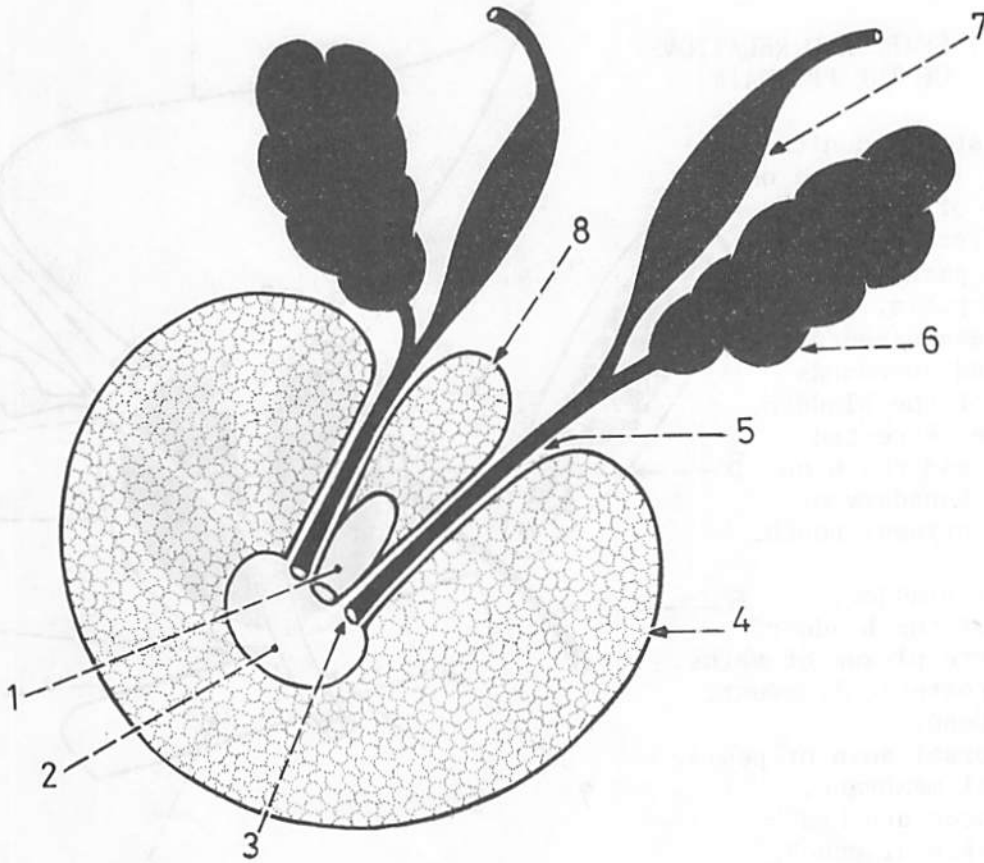


Fig.(453): SEMINAL VESICLES AND EJACULATORY DUCTS

The seminal vesicle is a highly coiled tube with side diverticula and is placed on the back of the bladder. Its lateral end is broad and blind and lies just below the termination of the ureter, while its medial end is narrow and joins the ductus deferens to form the ejaculatory duct.

The ejaculatory duct begins at the base of the prostate and passes forwards, downwards and medially along the side of the median lobe of the prostate and the prostatic utricle to open on the seminal colliculus in the middle of the posterior wall of the prostatic urethra.

- | | |
|------------------------------------|--------------------------------|
| 1. prostatic utricle. | 5. ejaculatory duct. |
| 2. prostatic urethra (T.S.). | 6. seminal vesicle. |
| 3. opening of ejaculatory duct. | 7. ampulla of ductus deferens. |
| 4. lateral lobe of prostate(T.S.). | 8. median lobe of prostate. |

Fig.(454): POSITION OF THE PROSTATE

It lies on the floor of the pelvis and is surrounded by a sheath from the pelvic fascia which contains prostatic plexus of veins.

- | |
|-------------------------------------|
| 1. peritoneum covering the bladder. |
| 2. paravesical fossa. |
| 3. pelvic fascia. |
| 4. floor of the pelvis. |
| 5. prostatic plexus of veins. |

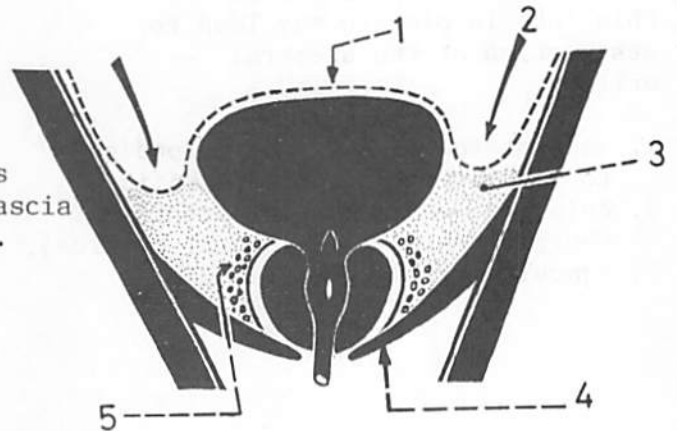


Fig.(455): SHAPE AND RELATIONS OF THE PROSTATE

The prostate is conical in shape and is situated on the floor of the pelvis a short distance behind the lower part of symphysis pubis. It has a broad base directed upwards and surrounds the neck of the bladder, and an apex directed downwards and rests on the upper boundary of the deep perineal pouch.

1. urinary bladder.
2. uvula of the bladder.
3. prostatic plexus of veins.
4. pubo-prostatic ligament.
5. pubic bone.
6. deep dorsal vein of penis.
7. perineal membrane.
8. membranous urethra.
9. deep perineal pouch.
10. upper boundary of deep perineal pouch.
11. apex of prostate.
12. prostatic sheath.
13. ejaculatory duct.
14. median lobe of prostate.

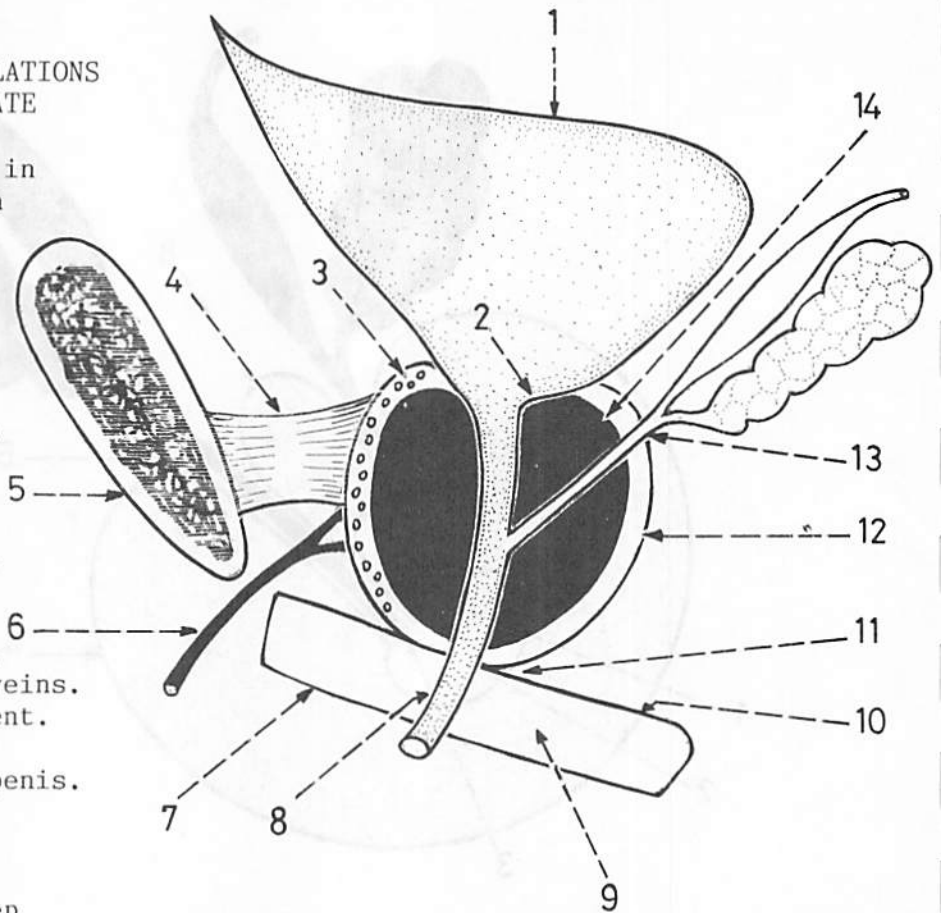


Fig.(456): ENLARGED MEDIAN LOBE OF PROSTATE

Normally, the median lobe slightly protrudes upwards into the bladder cavity just behind the internal urethral orifice to form the uvula of the bladder. Enlargement of this lobe in old age may lead to obstruction of the urethral orifice.

1. neck of the bladder corresponding to the internal urethral orifice.
2. enlarged median lobe of prostate (bulges behind the urethral orifice).
3. ejaculatory duct.

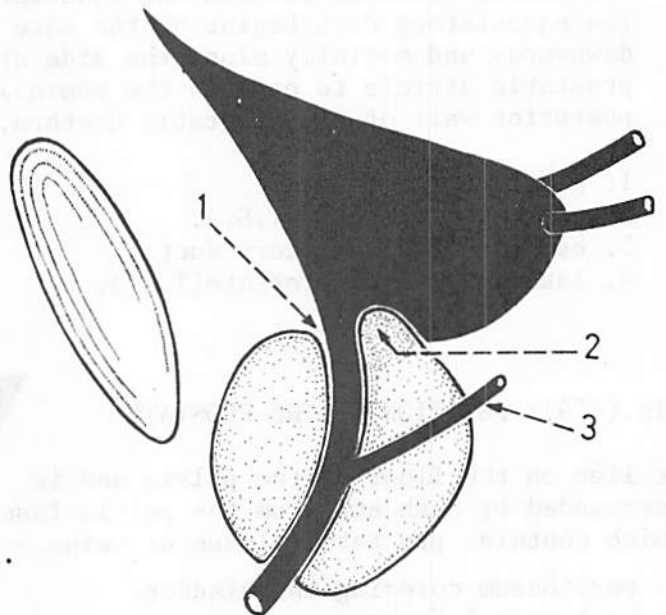
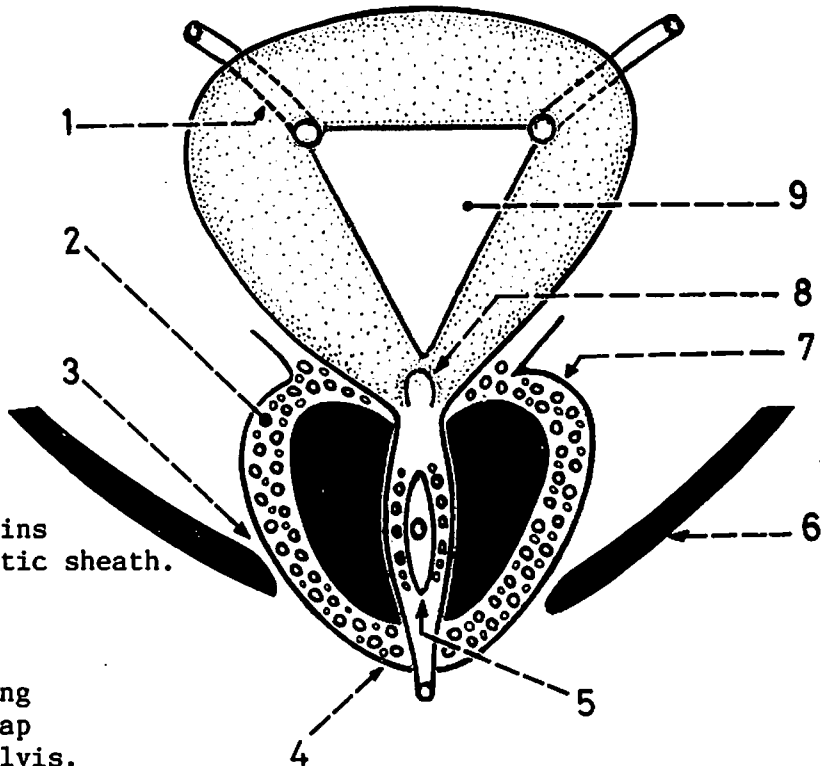


Fig.(457): PROSTATIC SHEATH
(coronal section)

The prostatic sheath is derived from the pelvic fascia and surrounds the prostate immediately outside its capsule. It lodges the prostatic plexus of veins in front and on the sides but is non-vascular posteriorly.

1. intramural part of the ureter.
2. prostatic plexus of veins embedded in the prostatic sheath.
3. infero-lateral surface of prostate (supported by the levator ani).
4. apex of prostate bulging through the anterior gap in the floor of the pelvis.
5. posterior wall of the prostatic urethra.
6. anterior part of levator ani which supports the side of the prostate (levator prostatae).
7. base of prostate.
8. uvula of urinary bladder.
9. trigone of the bladder.



* Note that the apex of the prostate protrudes through the anterior gap of the pelvic floor (between the free edges of the 2 levator ani muscles) to rest directly on the upper boundary of the deep perineal pouch (superior fascial layer of urogenital diaphragm).

Fig.(458): STRUCTURE OF THE PROSTATE
(horizontal section)

The prostate consists of glandular tissue and muscular tissue (unstriated), except in the isthmus which is devoid of glandular tissue.

1. deep dorsal vein of penis (joins the prostatic plexus of veins).
2. prostatic plexus of veins.
3. capsule of the prostate.
4. ejaculatory duct.
5. median lobe of prostate.
6. glandular tissue.
7. right lateral lobe.
8. prostatic urethra.
9. isthmus (no glandular tissue).

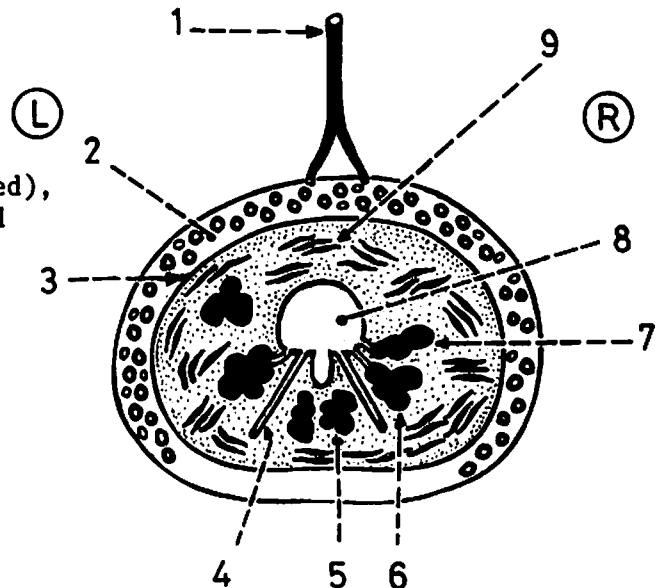


Fig.(459): BULBO-URETHRAL GLANDS

These are 2 small glands placed in the deep perineal pouch, one on each side of the membranous urethra. Their long ducts pierce the perineal membrane to open into the spongy urethra $2\frac{1}{2}$ cm below the perineal membrane.

1. membranous urethra.
2. spongy urethra.
3. duct of bulbo-urethral gland.
4. intra-bulbar fossa of spongy urethra.
5. perineal membrane.
6. deep perineal pouch.
7. superior fascia of urogenital diaphragm.
8. bulbo-urethral gland.

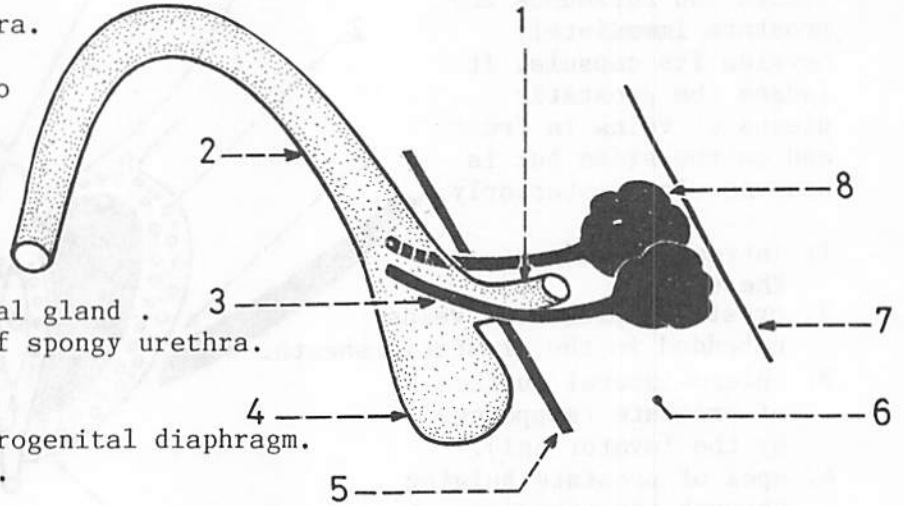


Fig.(460): PARTS OF THE PENIS

The penis consists of 2 parts: an attached part called root and a free pendulous part called body. The root consists of 2 crura and a bulb, and the body consists of 2 corpora cavernosa and one corpus spongiosum.

1. symphysis pubis.
2. corpora cavernosa.
3. glans penis.
4. external urethral orifice.
5. corpus spongiosum.
6. bulb of the penis.
7. right and left crura.

(a) Root of the penis.

(b) free part of the penis.

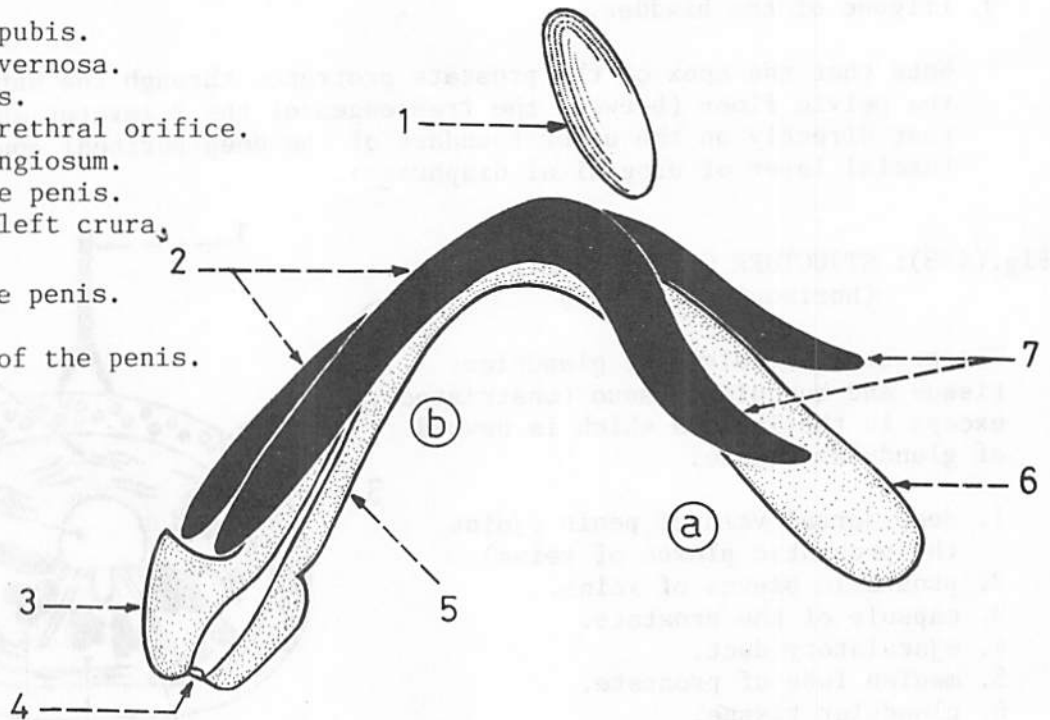
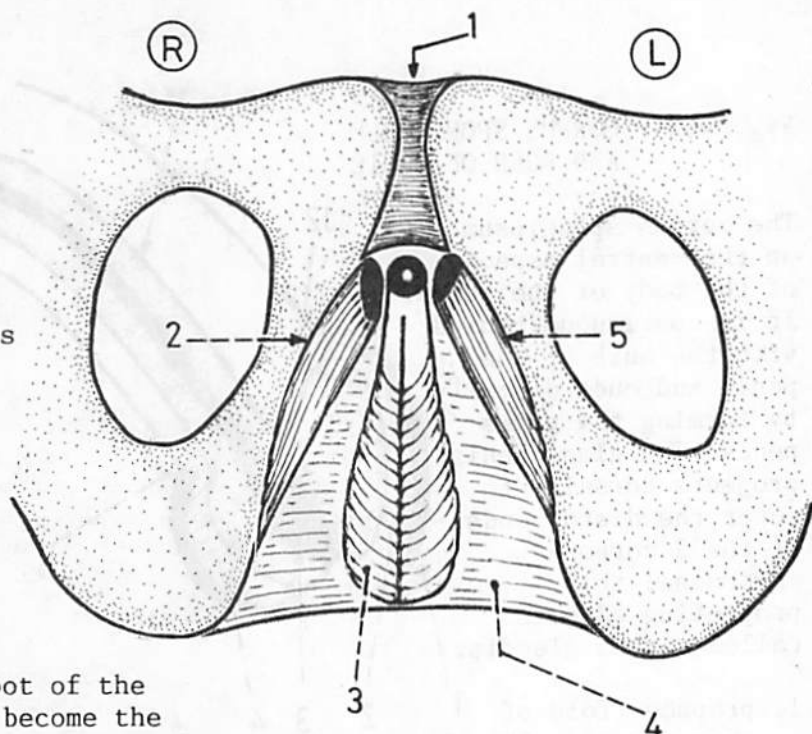


Fig.(461): ROOT OF THE PENIS

It consists of 2 crura and a bulb, all of which lie in the superficial perineal pouch below the perineal membrane. Each crus is an elongated mass of erectile tissue placed along the side of the pubic arch and is covered with the ischio-cavernosus muscle. The bulb lies on the midline of the perineal membrane and is covered by the bulbo-spongiosus muscle; it is traversed by the spongy urethra.

At the symphysis pubis the root of the penis ends where the 2 crura become the corpora cavernosa and the bulb becomes the corpus spongiosum.



1. symphysis pubis.
2. right crus.
3. bulb of the penis.
4. perineal membrane (inferior fascia of urogenital diaphragm).
5. left crus.

Fig.(462): TRANSVERSE SECTION IN THE BODY OF THE PENIS

The body of the penis consists of 3 corpora of erectile tissue: 2 corpora cavernosa lying side by side and a corpus spongiosum lying ventrally and between them. Dorsal to the corpora cavernosa run the nerves and vessels of the penis. All these structures are surrounded by membranous layer of superficial fascia "Colles' fascia".

1. dorsal artery of penis.
2. skin of the penis.
3. membranous layer of superficial fascia.
4. ventral aspect of the penis.
5. corpus spongiosum enclosing the spongy urethra and its artery.
6. corpus cavernosum enclosing the deep artery of penis.
7. dorsal nerve of penis.
8. deep dorsal vein of penis.
9. superficial dorsal vein of penis (in the superficial fascia).

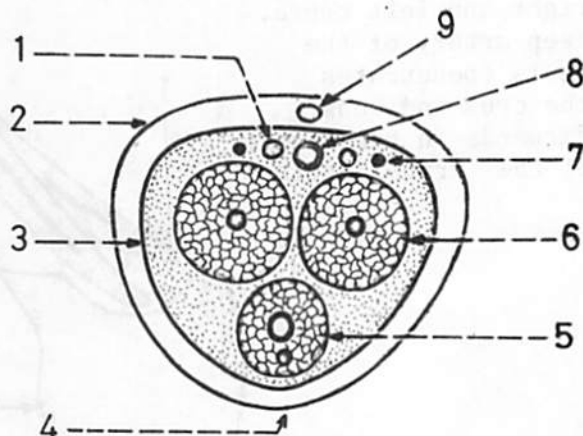


Fig.(463): CORPUS SPONGIOSUM
AND BULB OF PENIS

The corpus spongiosum lies on the ventral aspect of the body of the penis. It is continuous behind with the bulb of the penis and ends distally by forming the glans penis. The glans penis projects dorsally to cover the distal ends of the 2 corpora cavernosa; this projecting edge is called corona glandis.

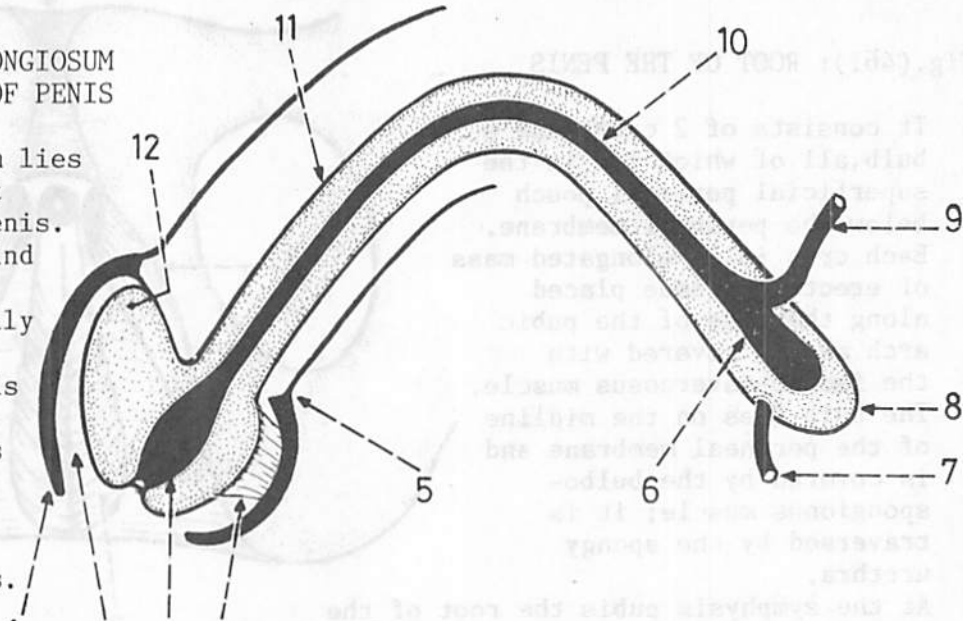
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1. prepuce (fold of skin covering the glans).
 2. preputial sac (the space between the prepuce and the glans).
 3. navicular fossa.
 4. frenulum of the prepuce.
 5. neck of the penis (the circular groove just behind the glans).
 6. intrabulbar fossa.
 7. artery of the bulb.
 8. bulb of the penis.
 9. membranous urethra.
 10. spongy urethra.
 11. corpus cavernosum.
 12. corona glandis.

Fig.(464): CORPORA CAVERNOSA AND THE 2 CRURA

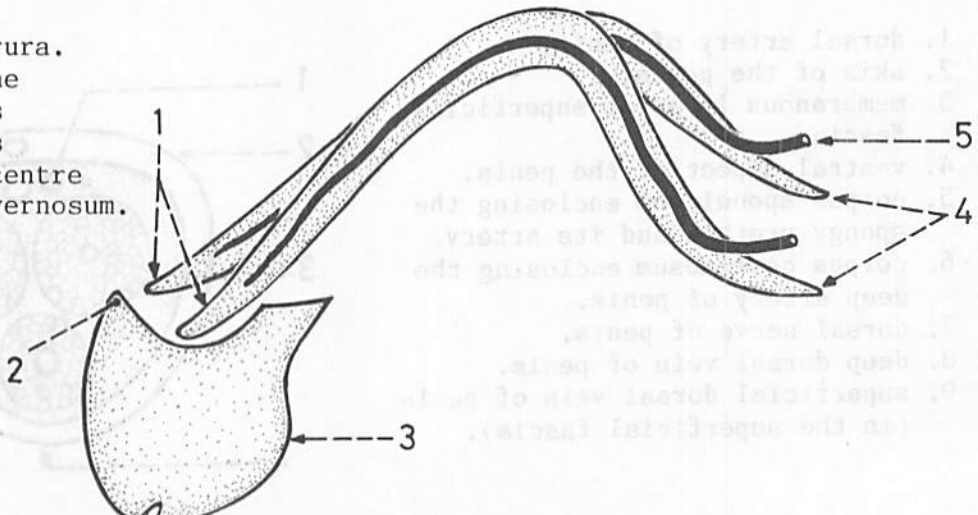
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1. distal ends of the 2 corpora cavernosa.
 2. corona glandis.
 3. glans penis.
 4. right and left crura.
 5. deep artery of the penis (penetrates the crus and runs forwards in the centre of the corpus cavernosum).

Fig.(465): GLANS PENIS AND PREPUCE

The glans penis is the expanded distal end of the corpus spongiosum. Its dorsal edge is projecting to form the corona glandis, while its ventral surface is connected with the prepuce by a median fold termed frenulum of the penis. The space separating the prepuce from the glans is called preputial sac.

1. neck of the penis (the groove just behind the glans).
2. corona glandis.
3. prepuce (fold of skin).
4. preputial sac.
5. glans penis.
6. frenulum of the prepuce.
7. body of the penis.

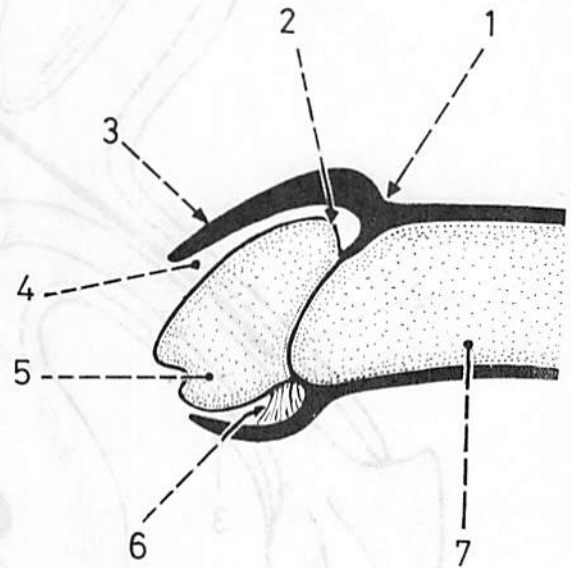
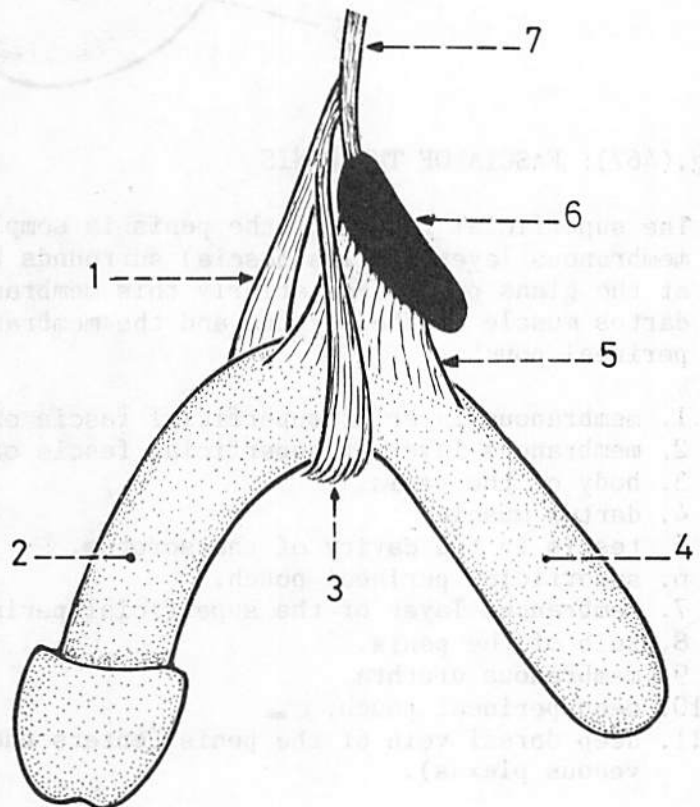


Fig.(466): LIGAMENTS OF THE PENIS

These are the fundiform and suspensory ligaments. The fundiform ligament arises from the lower part of the linea alba and surrounds the penis like a sling. The suspensory ligament arises from the front of the symphysis pubis and is attached to the dorsum of the penis.

1. fundiform ligament.
2. body of the penis.
3. the fundiform ligament curving around the penis at the junction of its root and its free part.
4. root of the penis.
5. suspensory ligament.
6. symphysis pubis.
7. linea alba.



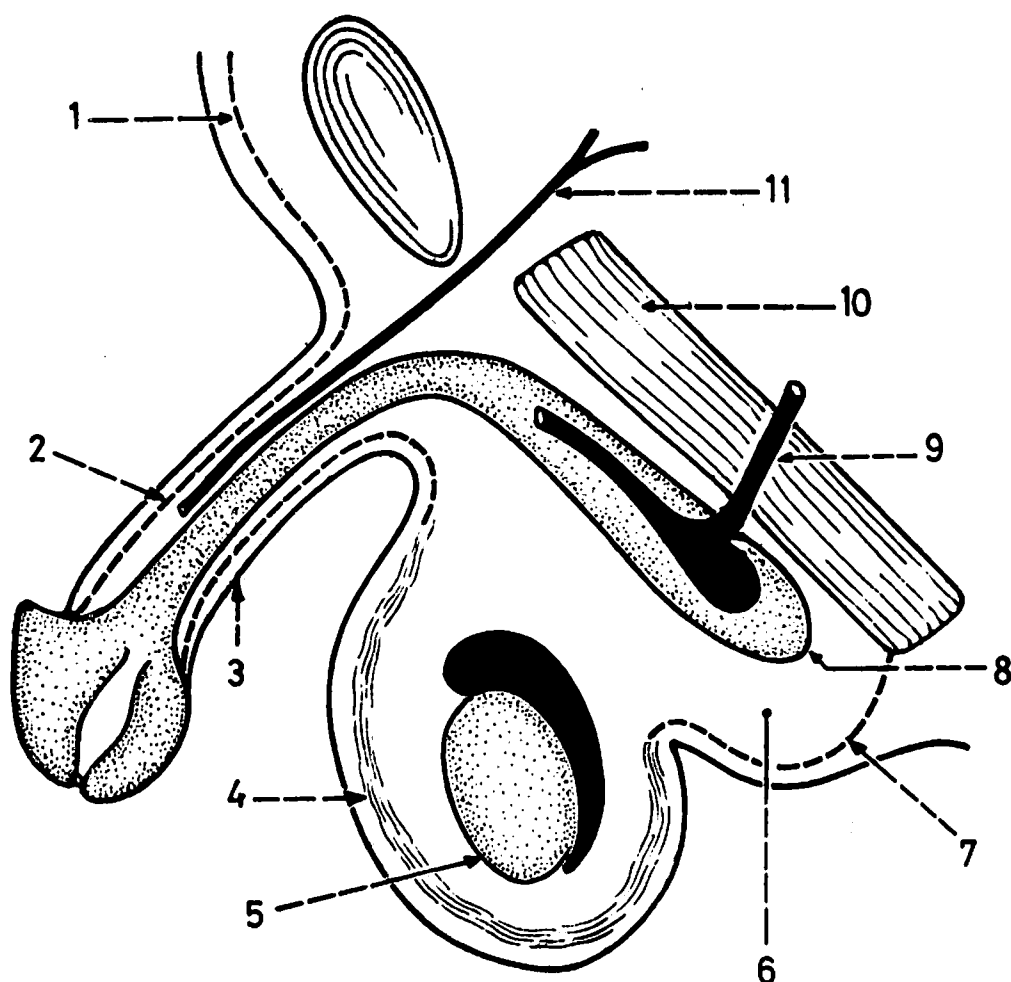


Fig.(467): FASCIA OF THE PENIS

The superficial fascia of the penis is completely devoid of fat and its deep membranous layer (Colles' fascia) surrounds the whole body of the penis but stops at the glans penis. Posteriorly this membranous layer is continuous with the dartos muscle of the scrotum and the membranous layer bounding the superficial perineal pouch.

1. membranous layer of superficial fascia of the anterior abdominal wall.
2. membranous layer of superficial fascia of the penis.
3. body of the penis.
4. dartos muscle.
5. testis in the cavity of the scrotum.
6. superficial perineal pouch.
7. membranous layer of the superficial perineal pouch.
8. bulb of the penis.
9. membranous urethra.
10. deep perineal pouch.
11. deep dorsal vein of the penis (enters the pelvis to join the prostatic venous plexus).

Fig.(468): STRUCTURES ON THE DORSUM OF THE PENIS

These are: the deep dorsal vein (a single vein in the midline), dorsal arteries (one on each side of the vein) and dorsal nerves (one on each side lateral to the arteries). These structures lie under cover of the membranous layer of superficial fascia.

1. deep dorsal vein of penis (enters the pelvis to join the prostatic venous plexus).
2. upper border of perineal membrane above which the deep dorsal vein enters the pelvis.
3. dorsal artery of the penis.
4. dorsal nerve of the penis.

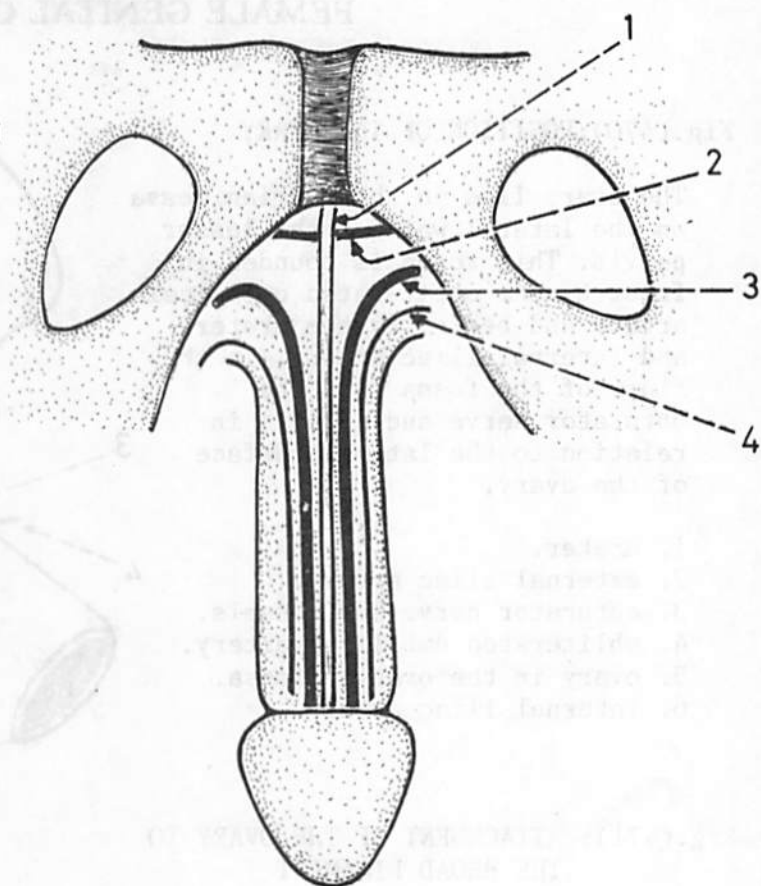
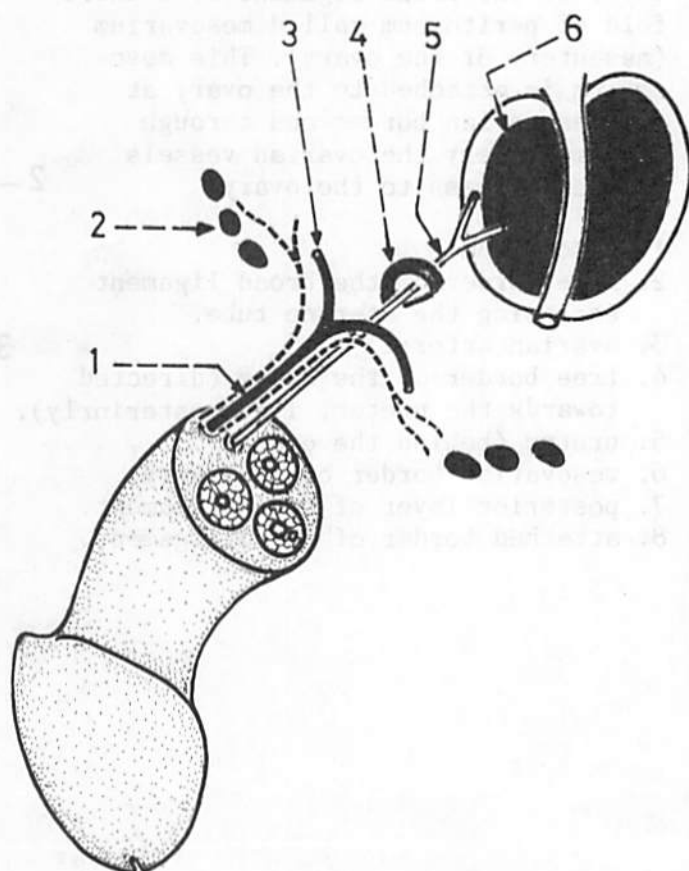


Fig.(469): VENOUS AND LYMPHATIC DRAINAGE OF THE PENIS

The deep dorsal vein drains the deep structures of the penis and ends in the prostatic plexus of veins, while the superficial dorsal vein of the penis drains the skin and fascia of the penis and ends in the external pudendal vein. The lymphatics of the penis except those of the glans drain into the superficial inguinal nodes; those of the glans pass to the deep inguinal nodes as well as to the external iliac nodes.

1. superficial dorsal vein of the penis.
2. superficial inguinal nodes.
3. superficial external pudendal vein.
4. inferior (arcuate) pubic ligament below which the deep dorsal vein enters the pelvis.
5. deep dorsal vein.
6. prostate.



FEMALE GENITAL ORGANS

Fig.(470): POSITION OF THE OVARY

The ovary lies in the ovarian fossa on the lateral wall of the lesser pelvis. This fossa is bounded in front by the obliterated umbilical artery and behind by the ureter and internal iliac artery. In the floor of the fossa run the obturator nerve and vessels in relation to the lateral surface of the ovary.

1. ureter.
2. external iliac artery.
3. obturator nerve and vessels.
4. obliterated umbilical artery.
5. ovary in the ovarian fossa.
6. internal iliac artery.

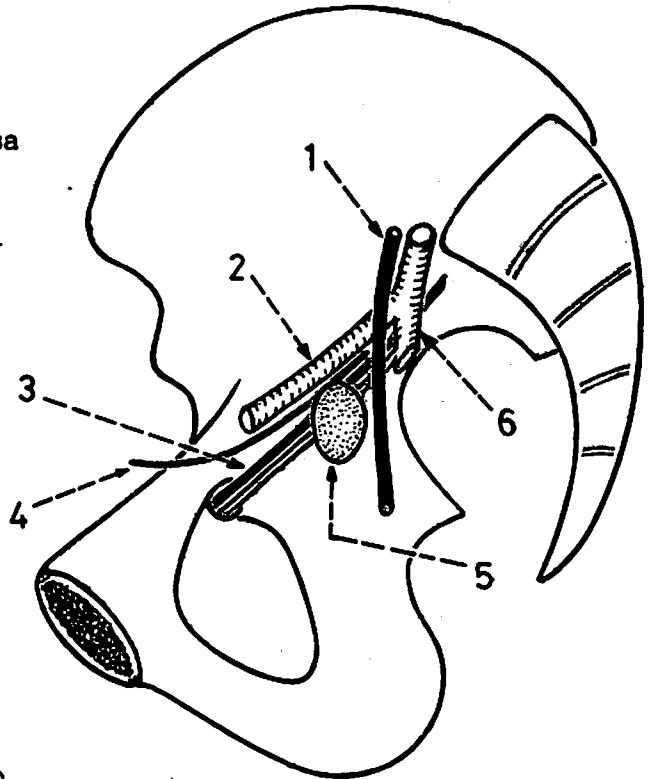


Fig.(471): ATTACHMENT OF THE OVARY TO THE BROAD LIGAMENT

The ovary is attached to the posterior layer of the broad ligament by a short fold of peritoneum called mesovarium (mesentery of the ovary). This mesovarium is attached to the ovary at its mesovarian border and through this mesentery the ovarian vessels and nerves pass to the ovary.

1. mesovarium.
2. free border of the broad ligament enclosing the uterine tube.
3. ovarian artery.
4. free border of the ovary (directed towards the ureter, i.e. posteriorly).
5. ureter (behind the ovary).
6. mesovarian border of the ovary.
7. posterior layer of broad ligament.
8. attached border of broad ligament.

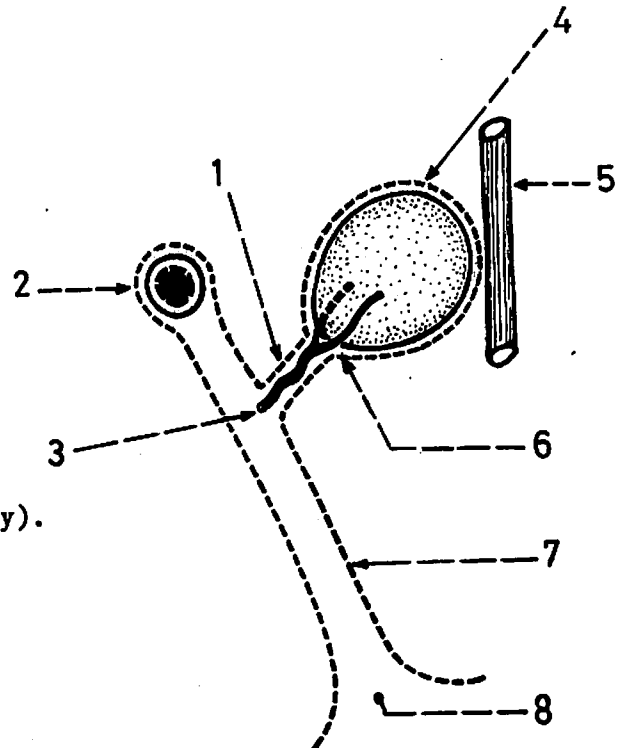


Fig.(472): STRUCTURES ATTACHED TO THE ENDS OF THE OVARY

The ovary has an upper end and a lower end. The upper end gives attachment to the ovarian fimbria and the suspensory ligament of the ovary, while the lower end gives attachment to the ligament of the ovary.

1. uterine tube.
2. round ligament of the uterus.
3. uterus.
4. ligament of the ovary.
5. ovary.
6. ureter (behind the ovary).
7. suspensory ligament of the ovary.
8. fimbriae of uterine tube.

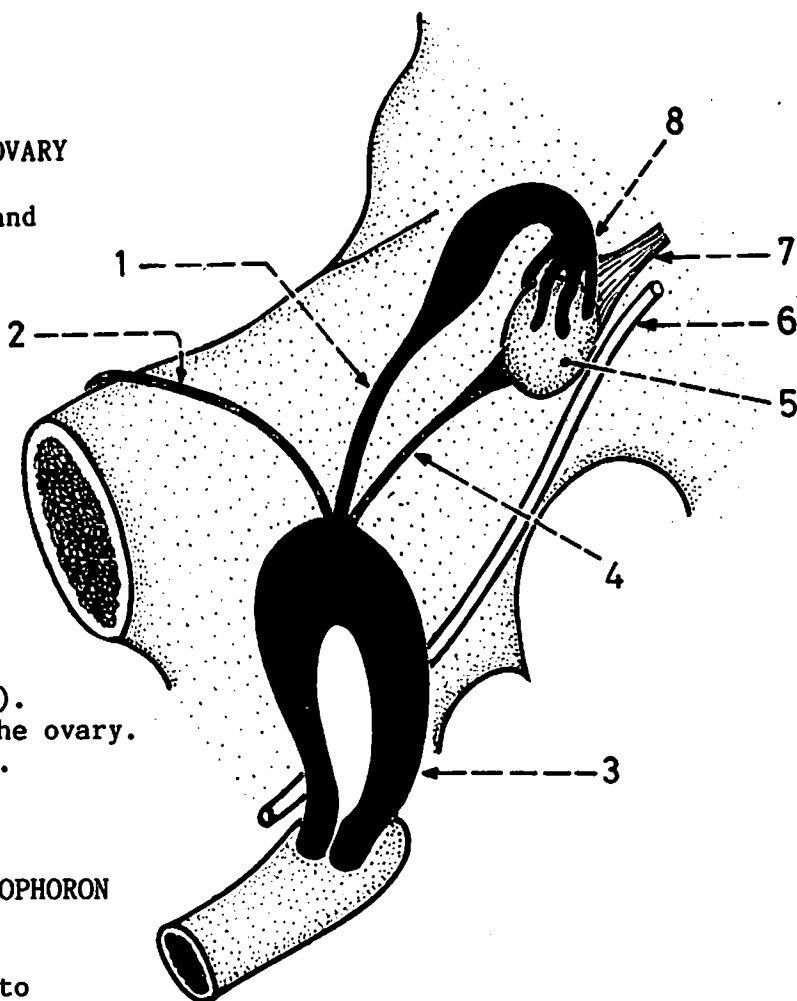


Fig.(473): EPOOPHORON AND PAROOPHORON

The epoophoron consists of short tubules placed close to the ovary, between it and the lateral part of uterine tube. The duct of epoophoron runs medially parallel to the uterine tube.

The paroophoron consists also of tubules placed medial to the epoophoron.

1. epoophoron.
2. paroophoron.
3. uterine tube.
4. duct of epoophoron.
5. ligament of ovary.
6. lower end of ovary.
7. upper end of ovary.
8. suspensory ligament of ovary.
9. ovarian vessels.
10. fimbriae.

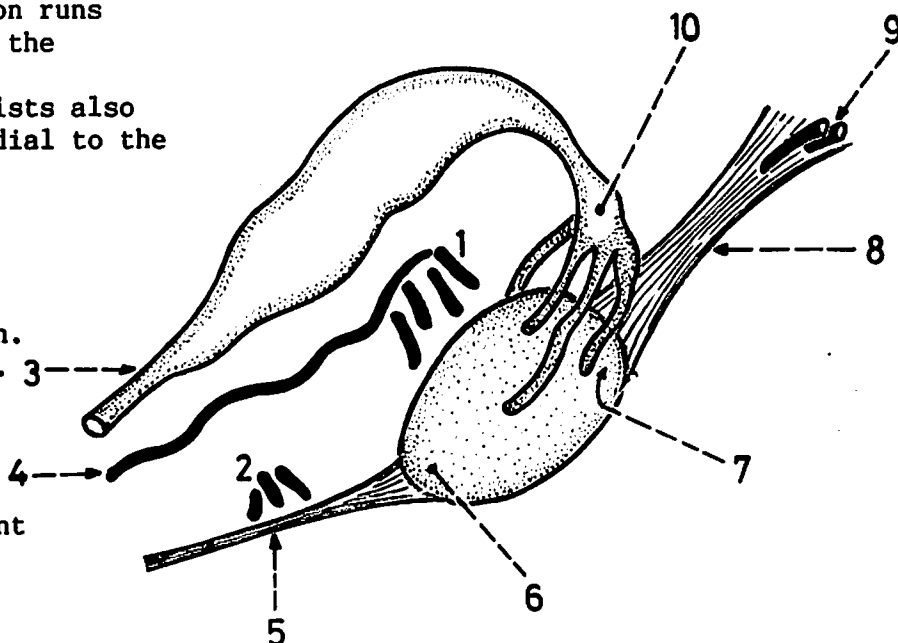


Fig.(474): LYMPHATIC AND BLOOD SUPPLY OF THE OVARY

The lymph vessels from the ovary end in the lateral aortic nodes. The ovarian artery arises from the abdominal aorta and enters the pelvis by crossing the proximal part of the external iliac artery; it enters the ovary through its mesovarium. Veins of the ovary form a short pampiniform plexus which leads to the ovarian vein.

1. ovary.
2. branch from the ovarian artery which anastomoses with the termination of the uterine artery.
3. pampiniform plexus of veins.
4. external iliac artery.
5. ovarian artery.
6. lateral aortic nodes.

* The right ovarian vein ends in the I.V.C., while the left vein ends in the left renal vein.

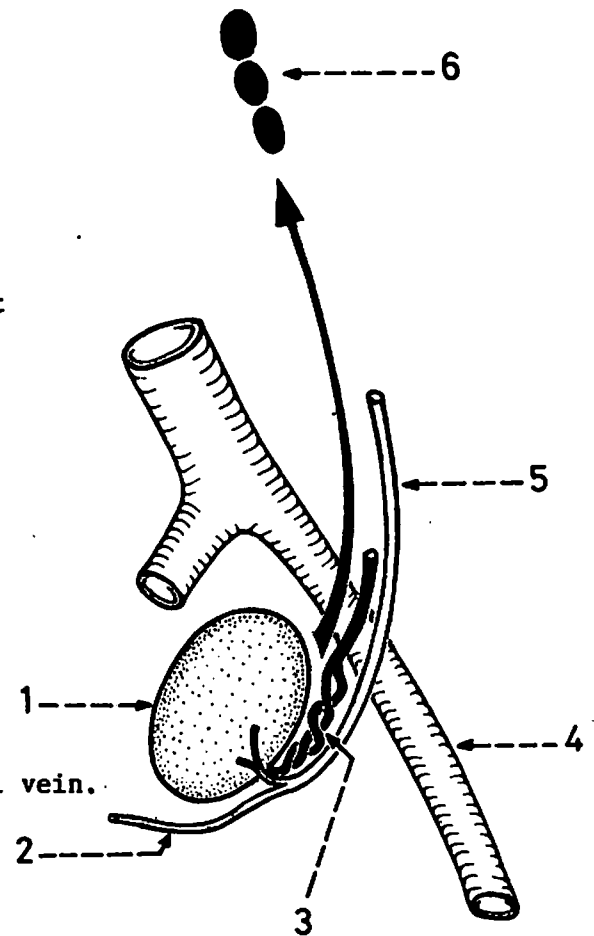


Fig.(475): UTERINE TUBE

The uterine tube is divided into 4 parts, from medial to lateral: uterine part (in the wall of the uterus), isthmus (narrow and cord-like), ampulla (dilated and tortuous) and infundibulum (funnel-shaped and fimbriated).

1. isthmus.
2. termination of uterine artery.
3. ampulla of uterine tube.
4. termination of ovarian artery.
5. infundibulum.
6. ovarian fimbria. (long and attached to the upper end of ovary).
7. ovary.
8. fimbriae.
9. ligament of the ovary.
10. mesosalpinx (mesentery of uterine tube).

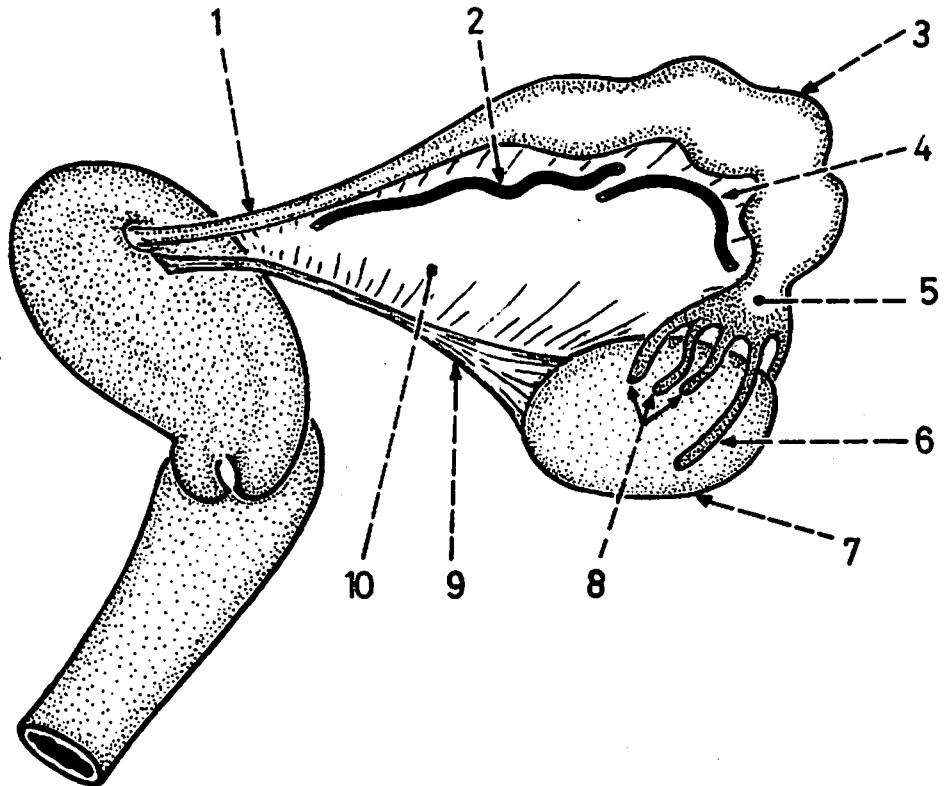


Fig.(476): PARTS OF THE UTERUS

The uterus consists of a body and a cervix. The upper convex part of the body above the entrance of the uterine tubes is called fundus. The cervix projects through the anterior wall of the vagina and is divisible into a supra-vaginal part (above the vagina) and a vaginal part (within the vagina). The cervical canal opens into the uterus by the internal os, and into the vagina by the external os.

1. fundus of the uterus.
2. anterior wall of the uterus.
3. cervical canal.
4. anterior fornix of vagina.
5. anterior wall of vagina.
6. uterine tube.
7. posterior wall of the uterus.
8. internal os.
9. supravaginal part of cervix.
10. posterior fornix of vagina.
11. vaginal part of cervix.
12. external os.

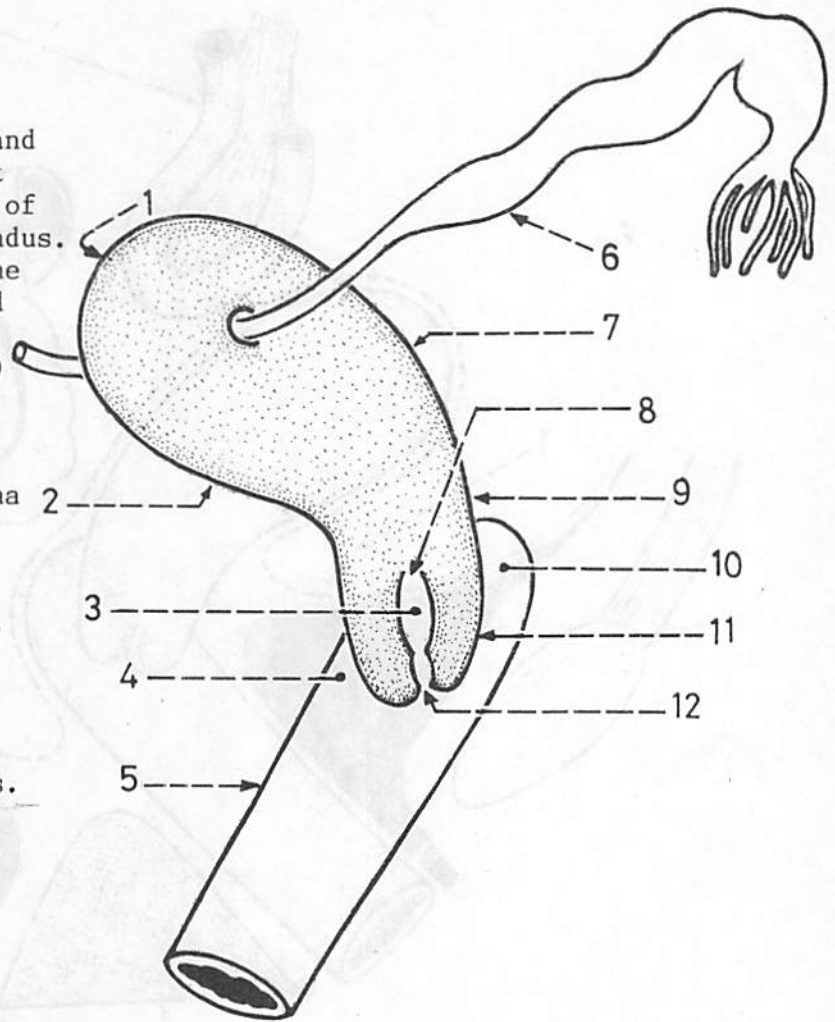
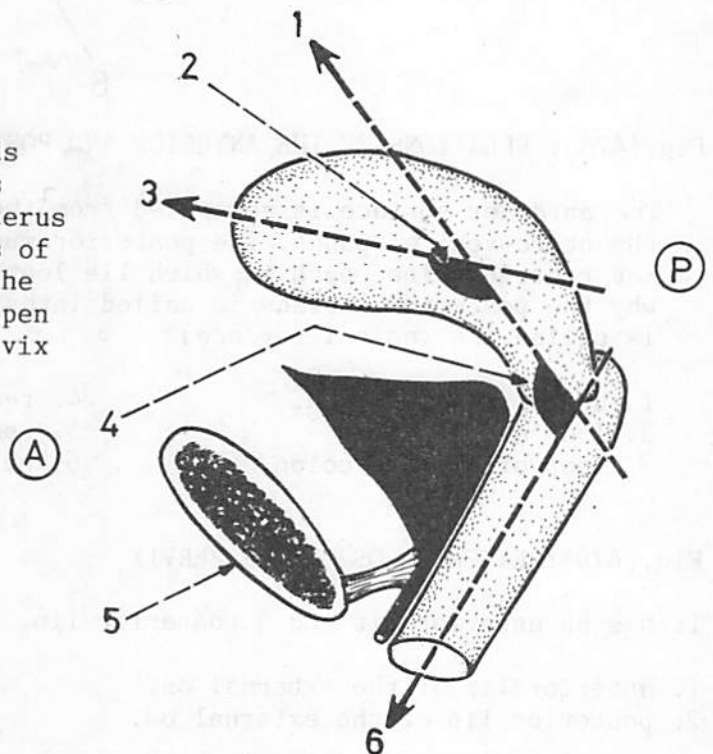


Fig.(477): POSITION OF THE UTERUS

The uterus lies in the lesser pelvis between the bladder and rectum. Its fundus is directed upwards and forwards while its cervix is directed downwards and backwards. The long axis of the uterus forms a right angle with the long axis of the vagina (anteverted position) and the long axis of the body forms an angle open forwards with the long axis of the cervix (anteflexed position).

1. long axis of the cervix.
2. angle of anteflexion.
3. long axis of the body.
4. angle of anteversion.
5. symphysis pubis.
6. axis of the vagina.



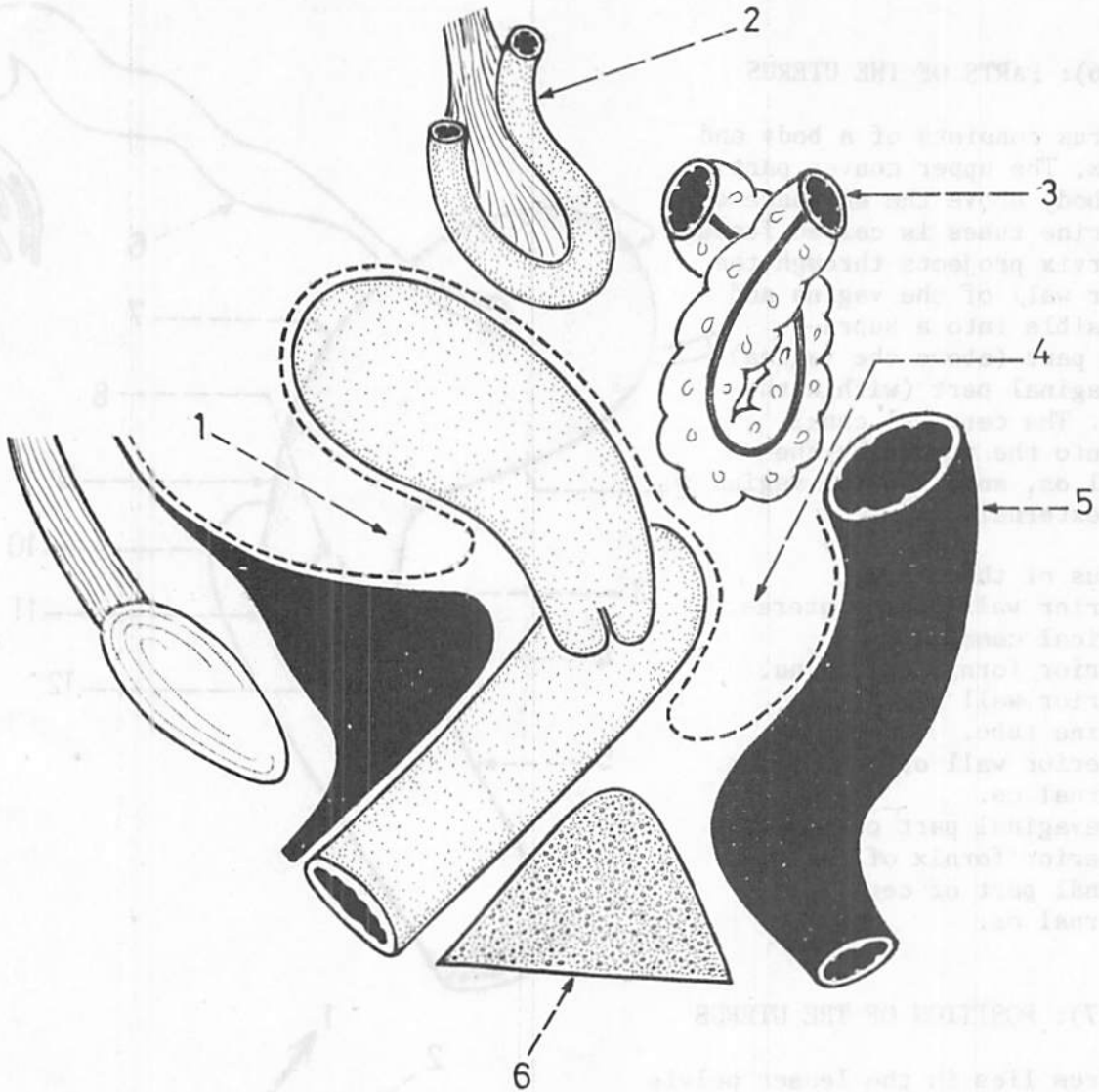


Fig.(478): RELATIONS OF THE ANTERIOR AND POSTERIOR SURFACES OF THE UTERUS

The anterior surface is separated from the upper surface of the bladder by the utero-vesical pouch. The posterior surface is separated from the rectum by the recto-uterine pouch in which lie loops of ileum and sigmoid colon (that is why the posterior surface is called intestinal surface and the anterior surface is called the vesical surface).

1. utero-vesical pouch.
2. loop of ileum.
3. loop of sigmoid colon.

4. recto-uterine pouch.
5. rectum.
6. perineal body.

Fig.(479): EXTERNAL OS OF THE CERVIX

It has an anterior lip and a posterior lip.

1. anterior lip of the external os.
2. posterior lip of the external os.

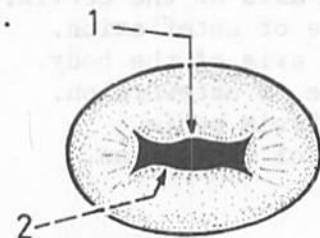


Fig.(480): PERITONEAL RELATIONS OF THE UTERUS

The peritoneum covers the whole posterior surface of the uterus, the fundus and most of the anterior surface. However, the anterior surface of the supravaginal part of the cervix is not covered by peritoneum. The lateral margin of the uterus gives attachment to the 2 layers of the broad ligament, and here the uterine artery ascends towards the uterine tube between the 2 layers of the ligament.

1. supravaginal part of the cervix (devoid of peritoneum anteriorly).
2. anterior layer of broad ligament.
3. uterine tube.
4. uterine artery (between the 2 layers of the broad ligament).
5. posterior layer of broad ligament.
6. rectouterine pouch of Douglas.

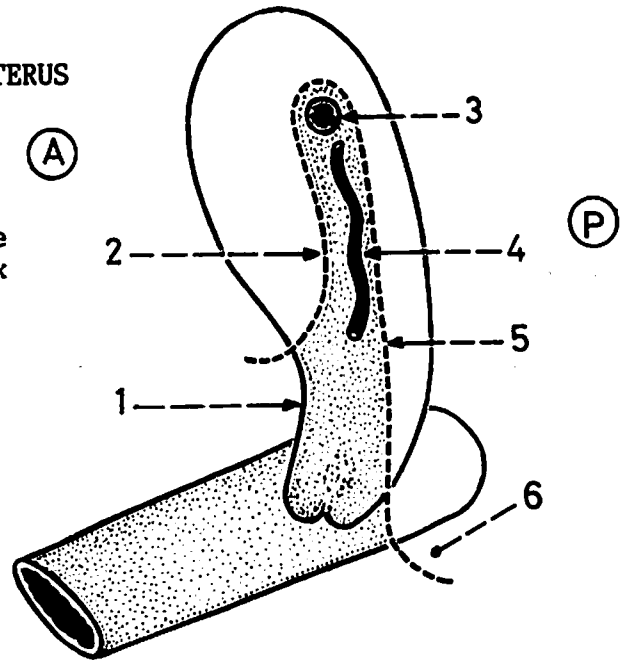


Fig.(481): UTERUS IN CORONAL SECTION

1. cavity of the uterus.
2. internal os.
3. isthmus of the uterus.
4. canal of the cervix.
5. lateral fornix of the vagina.
6. external os.
7. uterine artery (along the lateral margin of the uterus).
8. ureter (T.S.) situated 2 cm lateral to the supravaginal part of the cervix.
9. vaginal part of the cervix.

* The isthmus corresponds to the supravaginal part of the cervix, and it has been described by obstetricians to form the lower uterine segment during pregnancy.

* Note the important structures related to the side of the supravaginal part of the cervix, viz. the ureter and the uterine artery.

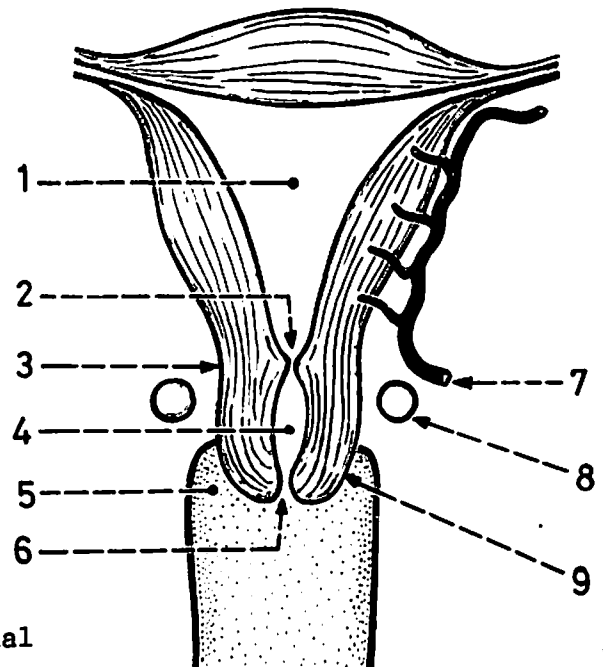


Fig.(482): POSITION OF THE BROAD LIGAMENT

The broad ligament extends from the lateral margin of the uterus to the lateral wall of the lesser pelvis, one on each side. The 2 ligaments and the uterus form together a transverse septum across the lesser pelvis. This septum divides the pelvic cavity into an anterior space which contains the bladder and a posterior space which contains the rectum.

1. right broad ligament.
2. uterus.
3. urinary bladder.
4. anterior space.
5. left broad ligament.
6. posterior space.
7. rectum.

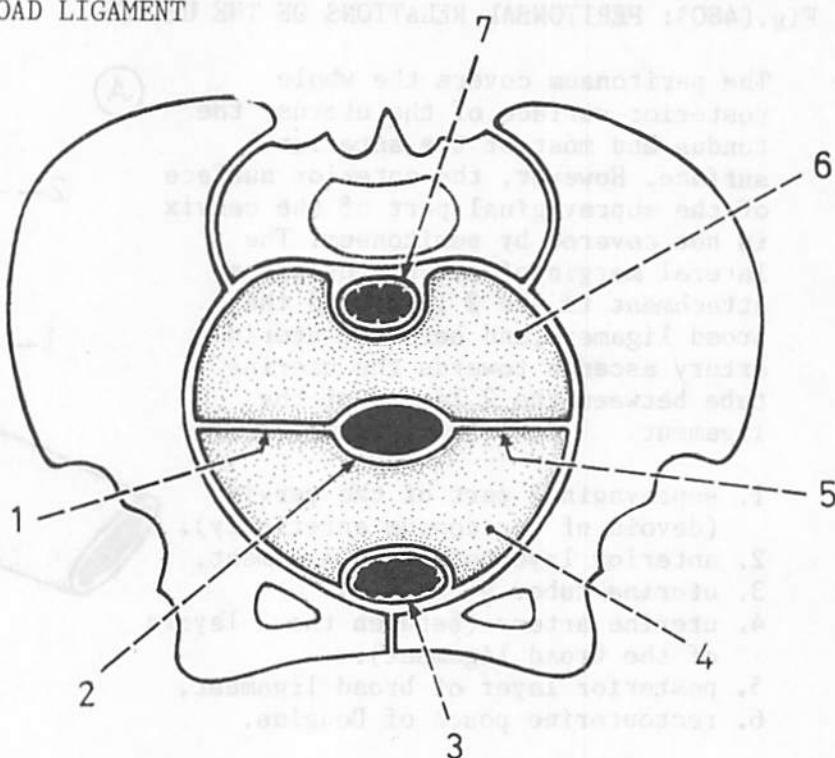


Fig.(483): LAYERS OF THE BROAD LIGAMENT (sagittal section)

The broad ligament consists of 2 layers: anterior and posterior. These 2 layers are continuous together around the uterine tube where they form the free border of the ligament, but they diverge from each other at the floor of the pelvis where they form its attached border.

1. uterine tube in the free border of the broad ligament.
2. anterior layer of broad ligament.
3. uterine artery ascending between the 2 layers close to the uterus.
4. vaginal branch of uterine artery.
5. ureter crossed by the uterine artery in the attached border of the ligament.
6. floor of the pelvis.
7. mesovarium.
8. ovary.
9. posterior layer of broad ligament.

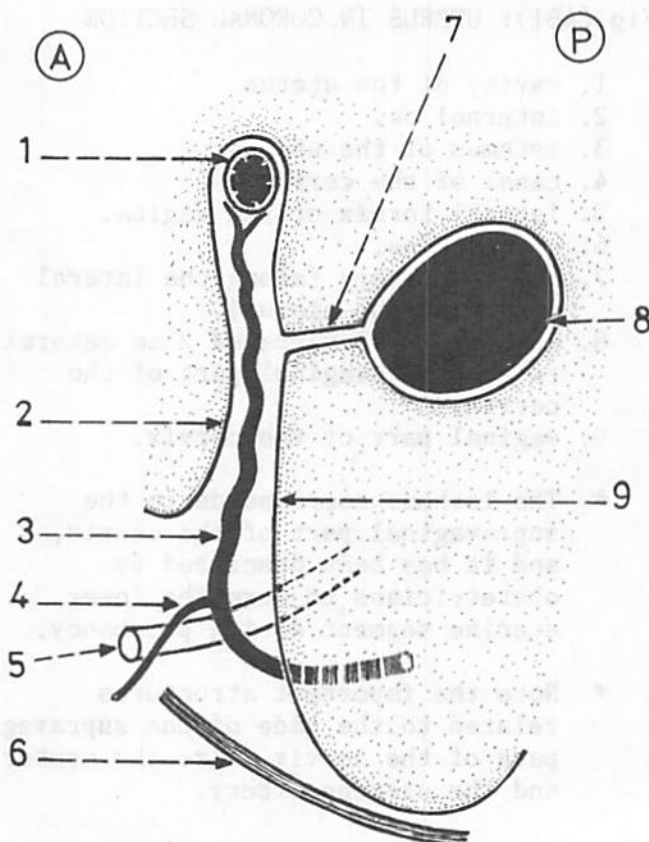
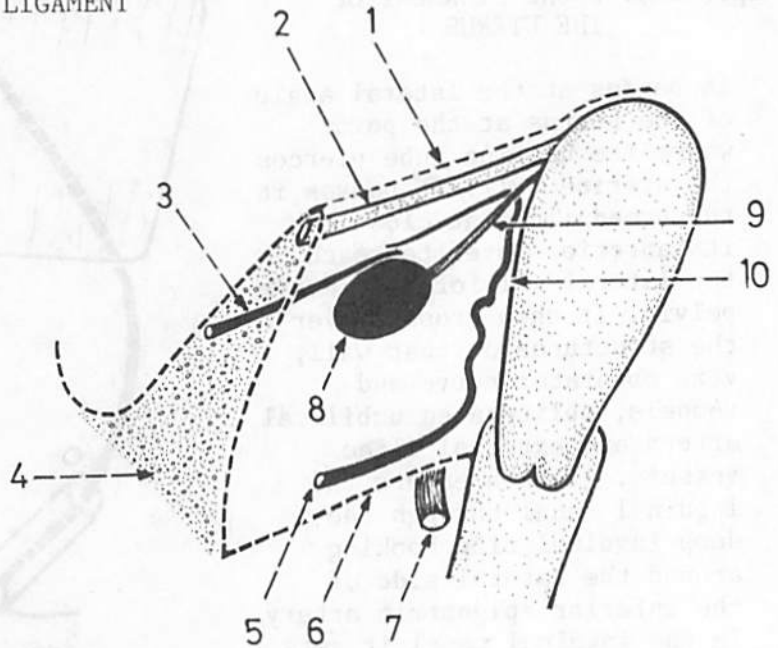


Fig.(484): CONTENTS OF THE BROAD LIGAMENT

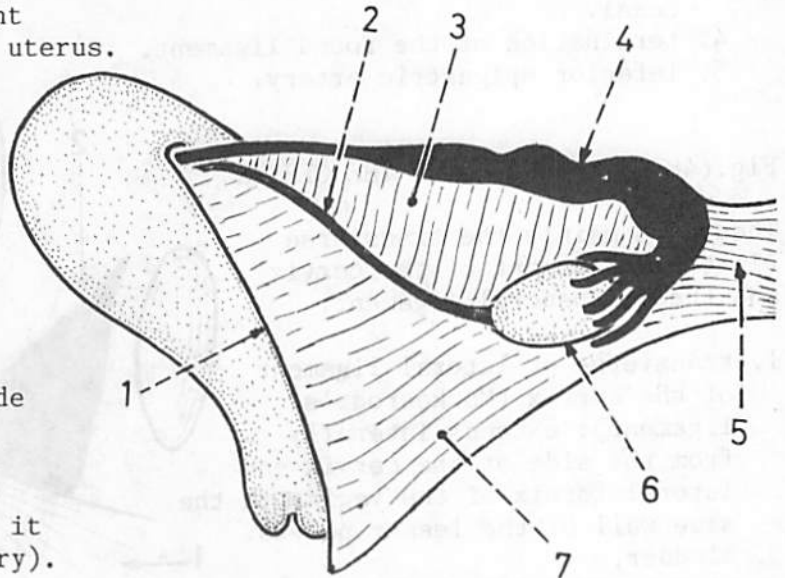
These are: uterine tube (in the free border), ureter (at the attached border), 2 arteries (uterine and ovarian), 2 ligaments (ligament of the ovary and round ligament of uterus) epoophoron and paroophoron and condensed extraperitoneal tissue termed parametrium.



1. free border of broad ligament.
2. uterine tube.
3. ovarian artery.
4. parametrium.
5. uterine artery.
6. attached border of broad ligament.
7. ureter.
8. ovary suspended from the posterior layer of the broad ligament.
9. ligament of the ovary (from the ovary to the side of the uterus close to the entrance of the uterine tube).
10. medial margin of the ligament attached to the side of the uterus.

Fig.(485): PARTS OF BROAD LIGAMENT

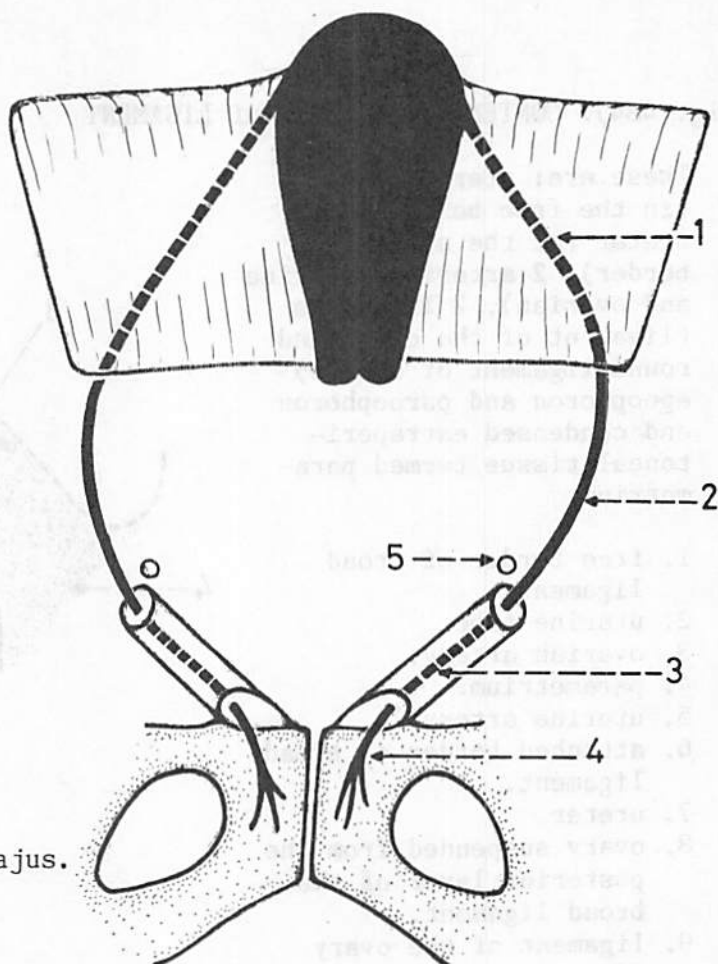
These are: mesovarium, mesosalpinx, suspensory ligament of the ovary and mesometrium.



1. medial border of broad ligament attached to the side of the uterus.
2. ligament of the ovary.
3. mesosalpinx (the part close to the uterine tube between it and the ligament of the ovary).
4. uterine tube.
5. suspensory ligament of the ovary (most lateral part of broad ligament).
6. ovary.
7. mesometrium (the part below the mesosalpinx).

Fig.(486): ROUND LIGAMENT OF THE UTERUS

it begins at the lateral angle of the uterus at the point where the uterine tube pierces the uterine wall. It passes in the broad ligament close to its anterior layer to reach the lateral wall of the lesser pelvis. It then crosses over the structures on that wall, viz. obturator nerve and vessels, obliterated umbilical artery and external iliac vessels. It then enters the inguinal canal through the deep inguinal ring hooking around the lateral side of the inferior epigastric artery. In the inguinal canal it gets the same coverings as the spermatic cord. It ends by getting attached to the labium majus.



1. round ligament of uterus in broad ligament.
2. round ligament on lateral wall of the pelvis.
3. round ligament in the inguinal canal.
4. termination of the round ligament.
5. inferior epigastric artery.

Fig.(487): LIGAMENTS OF THE CERVIX

These are mainly the transverse (lateral) ligament of the cervix and the uterosacral ligament.

1. transverse or lateral ligament of the cervix (Mackenrodt's ligament): extends laterally from the side of the cervix and lateral fornix of the vagina to the side wall of the lesser pelvis.
2. bladder.
3. utero-sacral ligament: extends backwards from the cervix to the front of the sacrum, one on each side of the rectum.

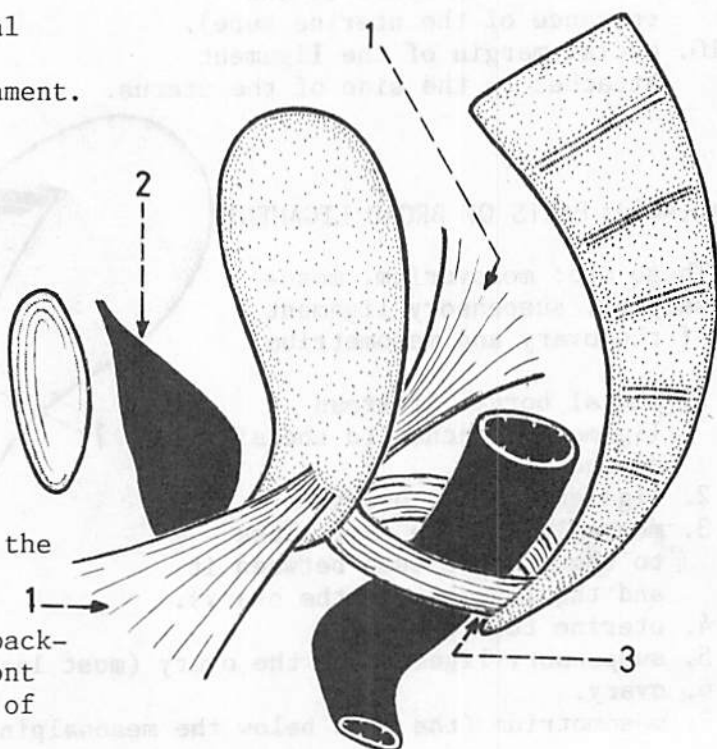


Fig.(488): THE 2 IMPORTANT STRUCTURES
RELATED TO THE SIDE OF THE CERVIX

These are the ureter and the uterine artery which come close to the side of the cervix, only 2 cm from it.

1. vaginal branch of uterine artery.
2. uterine tube (cut).
3. ureter running from behind forwards.
4. uterine artery crossing over the ureter.
5. vagina.
6. cervix of the uterus.

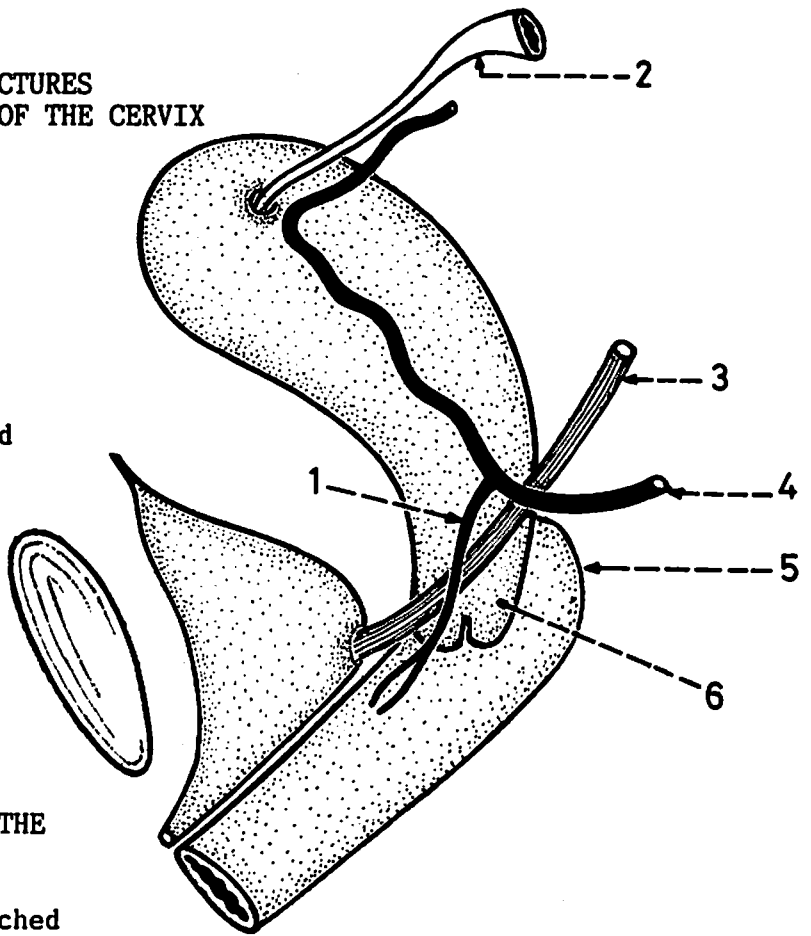


Fig.(489): FACTORS MAINTAINING THE
UTERUS IN POSITION

These are the ligaments attached to the uterus especially those attached to the cervix, the levator ani which surrounds the upper part of the vagina (sphincter vaginae) and the perineal body which supports the posterior wall of the vagina.

1. round ligament of the uterus.
2. transverse or lateral ligaments of the cervix.
3. utero-sacral ligaments.
4. sphincter vaginae (part of the levator ani).
5. perineal body.

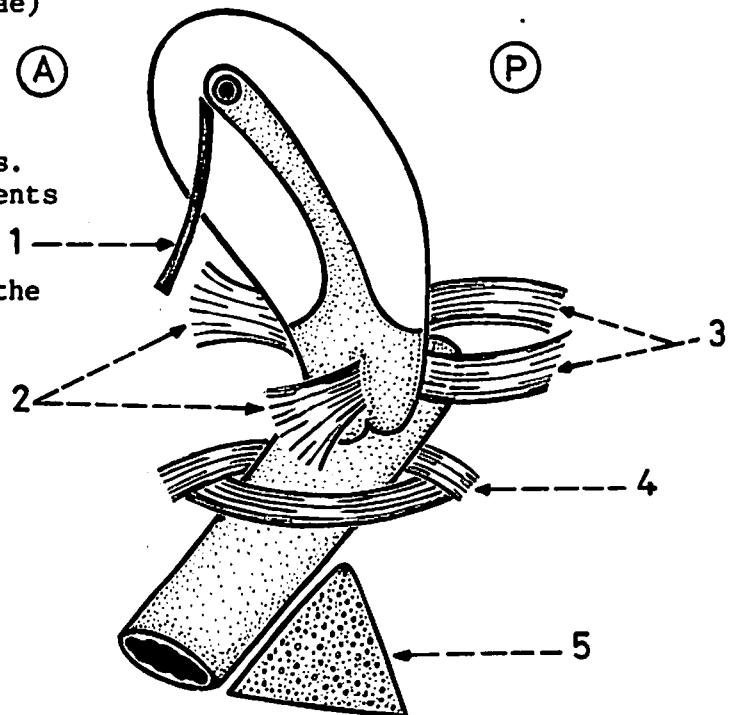


Fig.(490): LYMPHATIC DRAINAGE OF THE FEMALE GENITAL ORGANS

The female genital organs send their lymphatic vessels to 4 main groups of lymph nodes: aortic, external iliac, sacral and superficial inguinal.

1. external iliac nodes: drain the lower part of the body of uterus, cervix and most of the vagina.
2. lateral aortic and preaortic nodes: drain the fundus and upper part of the body of uterus, uterine tubes and ovaries.
3. sacral nodes: drain the cervix.
4. superficial inguinal nodes: drain a limited area of the body of uterus close to the entrance of uterine tube (vessels accompany the round ligament) and the lowermost part of the vagina below the hymen.

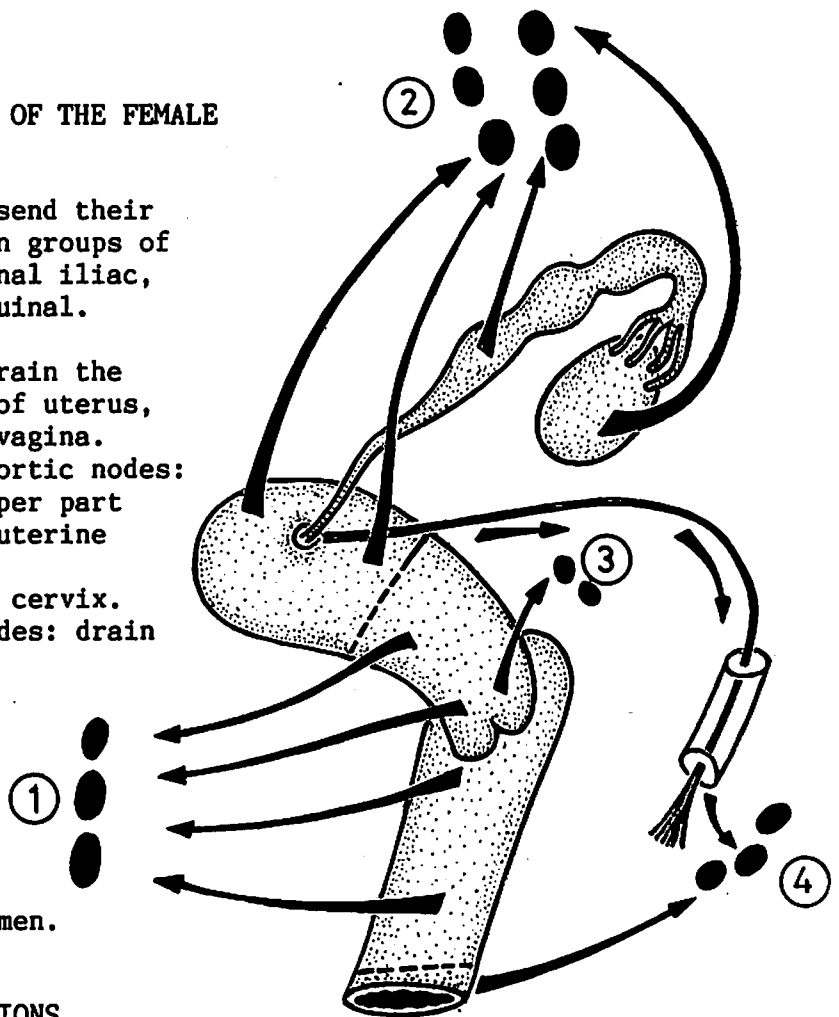


Fig.(491): POSITION AND RELATIONS OF THE VAGINA

The vagina extends upwards and backwards between the base of the bladder and the whole urethra (in front) and the recto-uterine pouch, middle 1/3 of rectum and perineal body (behind).

1. urinary bladder.
2. urethra.
3. perineal body.
4. loose fibro-areolar tissue between the middle 2/4 of the vagina and lower 1/3 of rectum.
5. recto-uterine pouch (behind the upper 1/4 of the vagina).
6. upper end of the vagina.
7. body of the uterus.

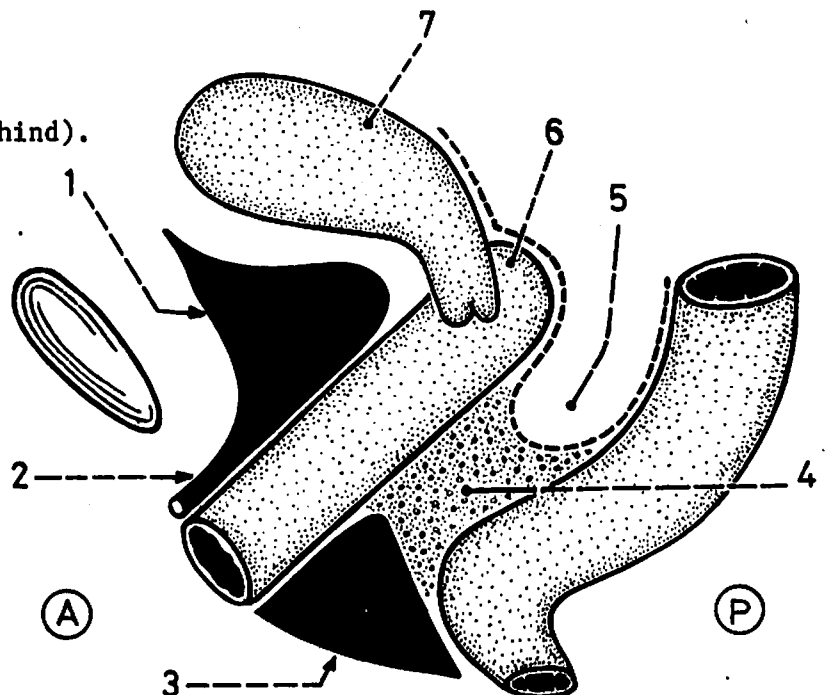


Fig.(492): SIDE RELATIONS OF THE VAGINA

The vagina is related on each side to the free medial border of the levator ani (indicated by arrow).

It is known that the anterior fibres of the levator ani sweep backwards and downwards across the sides of the vagina to be inserted into the perineal body behind the vagina. These fibres act as an important sphincter for the vagina and thus called sphincter vaginae.

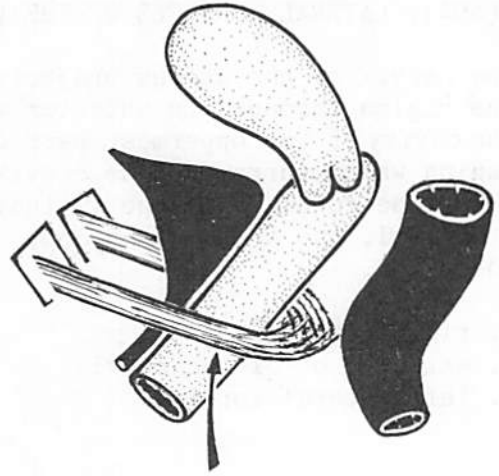


Fig.(493): RELATION OF THE URETER TO THE VAGINA

The terminal part of the ureter crosses just above the lateral fornix of the vagina. At this site it lies 2 cm lateral to the supravaginal part of the cervix and is crossed by the uterine artery. Very close to the bladder the terminal part of the ureter comes in front of the vagina.

1. ureter just above the lateral fornix of the vagina.
2. uterine artery crossing over the ureter 2 cm lateral to the cervix.
3. termination of the ureter placed in front of the vagina.
4. vaginal branch of uterine artery.

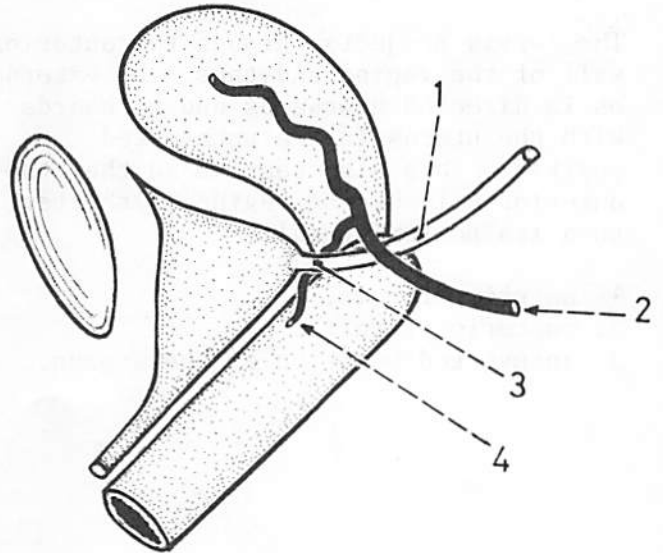


Fig.(494): LATERAL FORNICES OF THE VAGINA

The cervix of the uterus projects into the vagina through its anterior wall. The cavity of the uppermost part of the vagina which surrounds the cervix forms the fornices of the vagina: 2 lateral, one anterior and one posterior.

1. right lateral fornix.
2. external os of the cervix.
3. left lateral fornix.

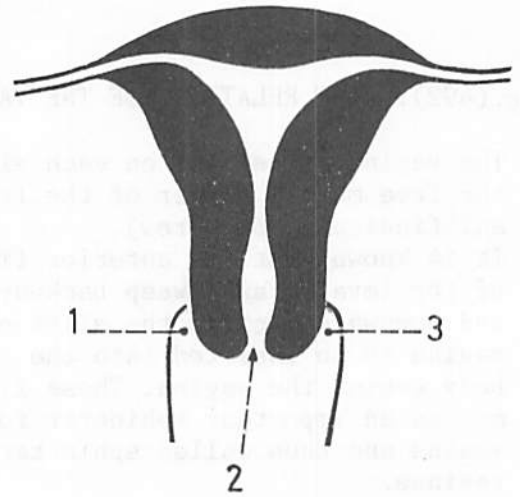


Fig.(495): ANTERIOR AND POSTERIOR FORNICES OF THE VAGINA

The cervix projects through the anterior wall of the vagina and thus the external os is directed downwards and backwards with the uterus in the anteverted position. This also results in that the anterior wall of the vagina is shorter than its posterior wall.

1. anterior fornix.
2. posterior fornix.
3. anteverted position of the uterus.

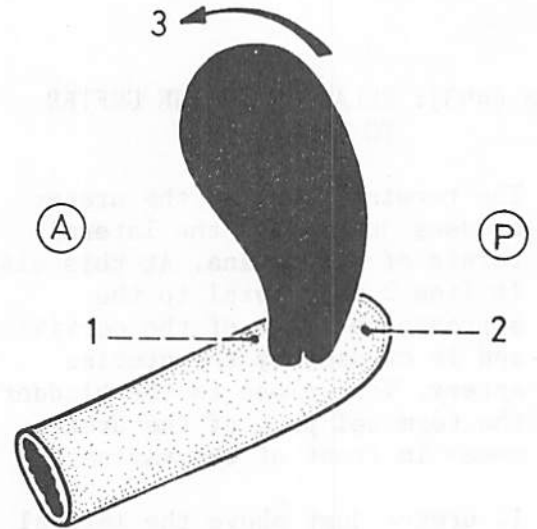


Fig.(496): RETROVERTED POSITION OF UTERUS

Normally in the anteverted position, the long axis of the uterus forms about a right angle with the axis of the vagina. In retroversion, the uterus deviates backwards towards the posterior wall of the pelvis.

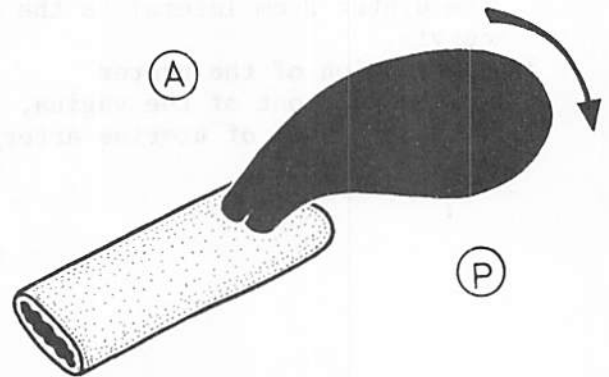


Fig.(497): RELATIONS OF THE VAGINAL ORIFICE

It opens into the vestibule of the vagina which is the cleft between the 2 labia minora. The vaginal orifice has the opening of the urethra immediately in front of it. On each side of the orifice lie a greater vestibular gland and 1/2 of the bulb of the vestibule.

1. symphysis pubis.
2. clitoris.
3. vaginal orifice.
4. greater vestibular gland.
5. external urethral orifice.
6. 1/2 of the bulb of the vestibule (the bulb of the vestibule is the homologue of the bulb of penis in the male).
7. anal orifice.
8. coccyx.

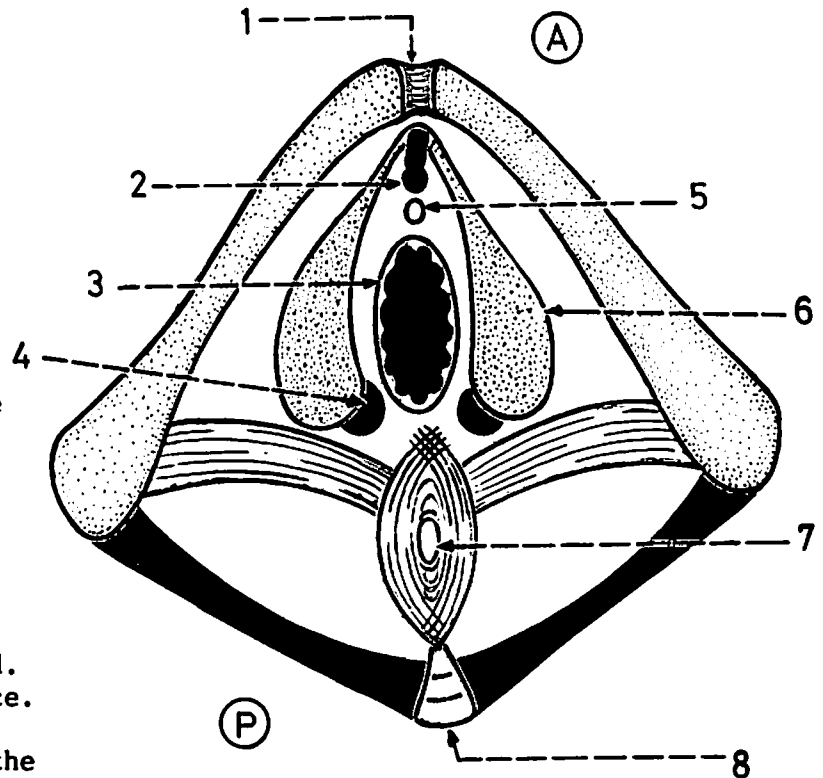


Fig.(498): VESSELS OF THE VAGINA

The vagina has 2 azygos arteries: anterior and posterior. They run longitudinally one in front and one behind the vagina. These azygos arteries are formed by the vaginal arteries and by branches from the uterine and middle rectal arteries. The veins of the vagina form 2 plexuses one on each side.

1. uterine artery.
2. vaginal vein draining the vaginal venous plexus.
3. vaginal venous plexus (left).
4. posterior azygos artery.
5. vaginal venous plexus (right).
6. anterior azygos artery.

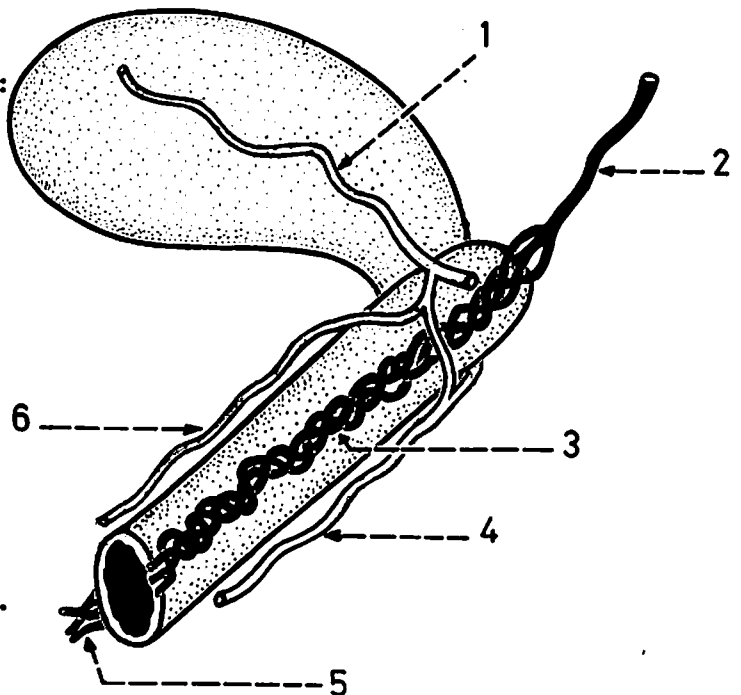


Fig.(499): PARTS OF THE VULVA

The vulva is formed of the following external genital organs: mons pubis, labia majora, labia minora, vestibule of the vagina, clitoris, bulb of the vestibule and the greater vestibular glands.

1. external urethral orifice.
2. vaginal orifice.
3. anal orifice.
4. mons pubis.
5. clitoris.
6. labia minora.
7. labia majora.
8. frenulum of labia minora (fourchette).
9. posterior commissure (connects the posterior ends of the labia majora together).

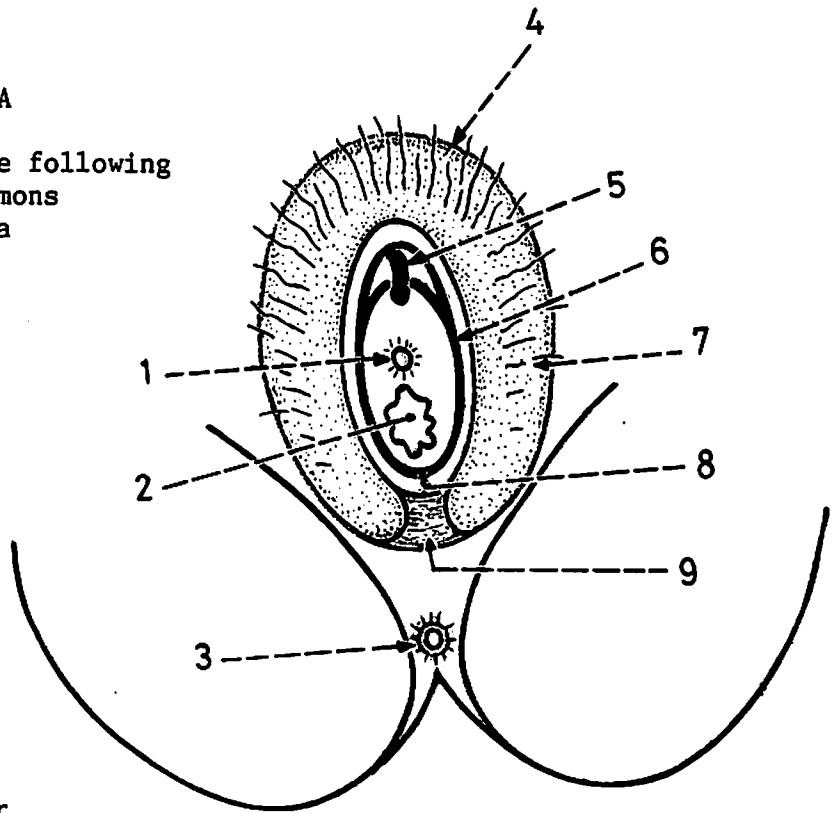
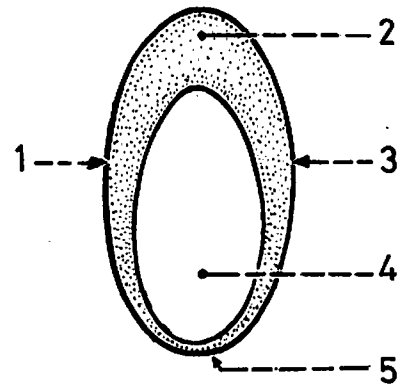


Fig.(500): LABIA MAJORA AND LABIA MINORA

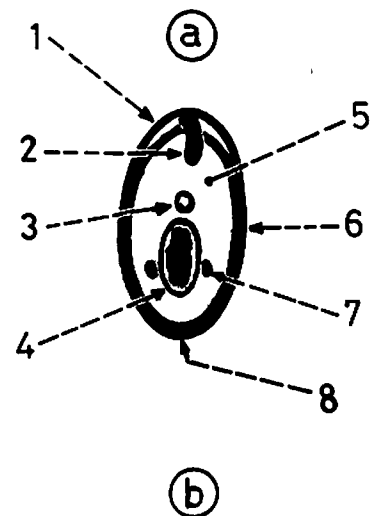
- (a) Labia majora: these are 2 skin folds which form the lateral boundaries of the pudendal cleft.

1. right labium majus.
2. mons pubis.
3. left labium majus.
4. pudendal cleft.
5. posterior commissure.



- (b) Labia minora: these are 2 small skin folds which are devoid of fat. They lie to the inner side of the labia majora and form the lateral boundaries of a cleft called the vestibule of the vagina. In this vestibule the vaginal orifice and the external urethral orifice are situated. The anterior ends of the 2 labia minora divide to surround the clitoris.

1. anterior ends of labia minora.
2. clitoris.
3. external urethral opening.
4. vaginal orifice.
5. vestibule of the vagina.
6. labium minus.
7. opening of the greater vestibular gland.
8. frenulum of labia minora (fourchette).



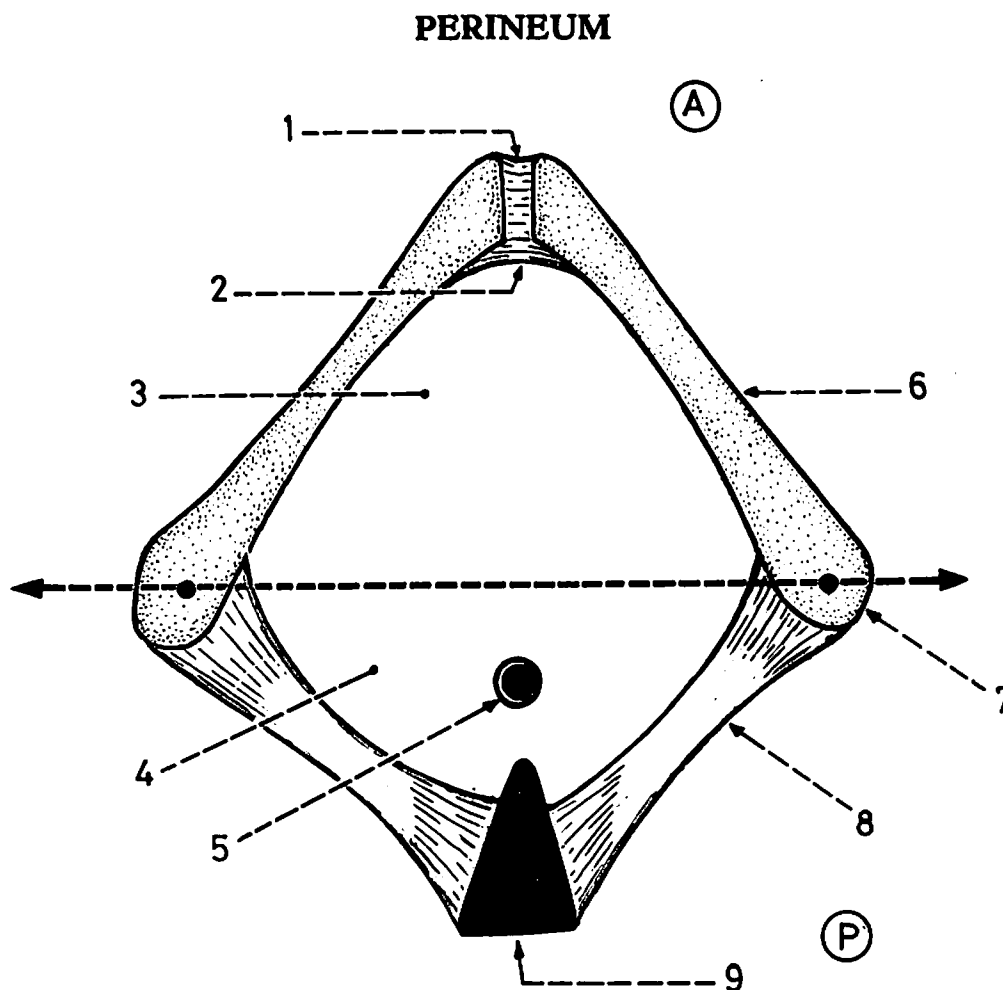


Fig.(501): BOUNDARIES AND DIVISIONS OF THE PERINEUM

The perineum overlies the outlet of the pelvis. It is lozenge-shaped and is bounded by the pubic arch and inferior (arcuate) pubic ligament in front, tip of the coccyx behind and ischial tuberosity and sacro-tuberous ligament on each side. It is divided by a transverse line drawn between the 2 ischial tuberosities into 2 regions (anterior and posterior). The anterior region is called the urogenital region or triangle (contains external urogenital organs), while the posterior region is called anal region or triangle (contains the anal canal).

1. symphysis pubis.
2. inferior (arcuate) pubic ligament.
3. urogenital triangle (region).
4. anal triangle (region).
5. anal canal.
6. side of the pubic arch.
7. ischial tuberosity.
8. sacro-tuberous ligament.
9. coccyx.

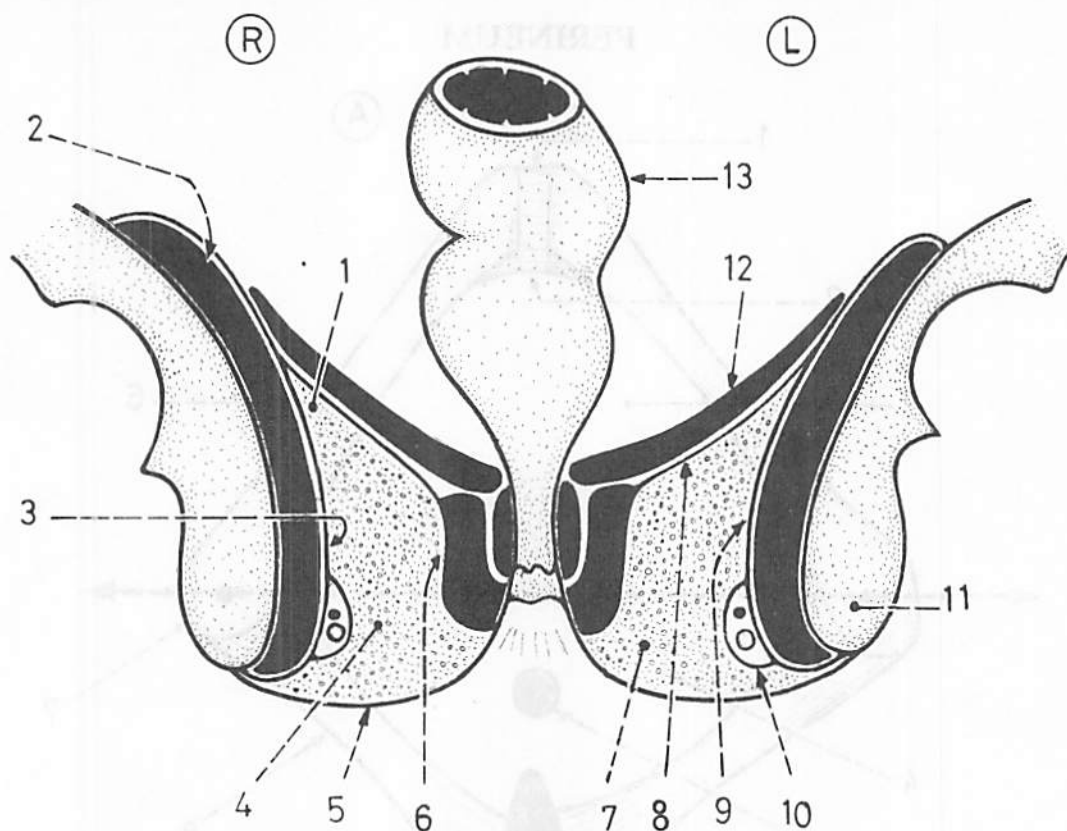


Fig.(502): THE 2 ISCHIO-RECTAL FOSSAE
(coronal section)

The anal triangle contains the anal canal in the midline and an ischio-rectal fossa on each side. The ischio-rectal fossa is a wedge-shaped space on the side of the anal canal. Its base is directed downwards towards the skin and its apex is directed upwards at the line of meeting of the levator ani and obturator fascia. It is bounded medially by the sphincter ani externus (around the anal canal) and the levator ani with the fascia covering its inferior surface (inferior fascia of pelvic diaphragm). It is bounded laterally by the ischial tuberosity and obturator internus muscle together with its covering fascia (obturator fascia).

1. apex of ischiorectal fossa.
2. obturator internus muscle.
3. obturator fascia.
4. right ischio-rectal fossa.
5. base of ischio-rectal fossa.
6. external anal sphincter.
7. left ischio-rectal fossa.
8. inferior fascia of pelvic diaphragm.
9. obturator fascia.
10. pudendal canal (in the lateral wall of the ischio-rectal fossa).
11. ischial tuberosity.
12. levator ani.
13. rectum.

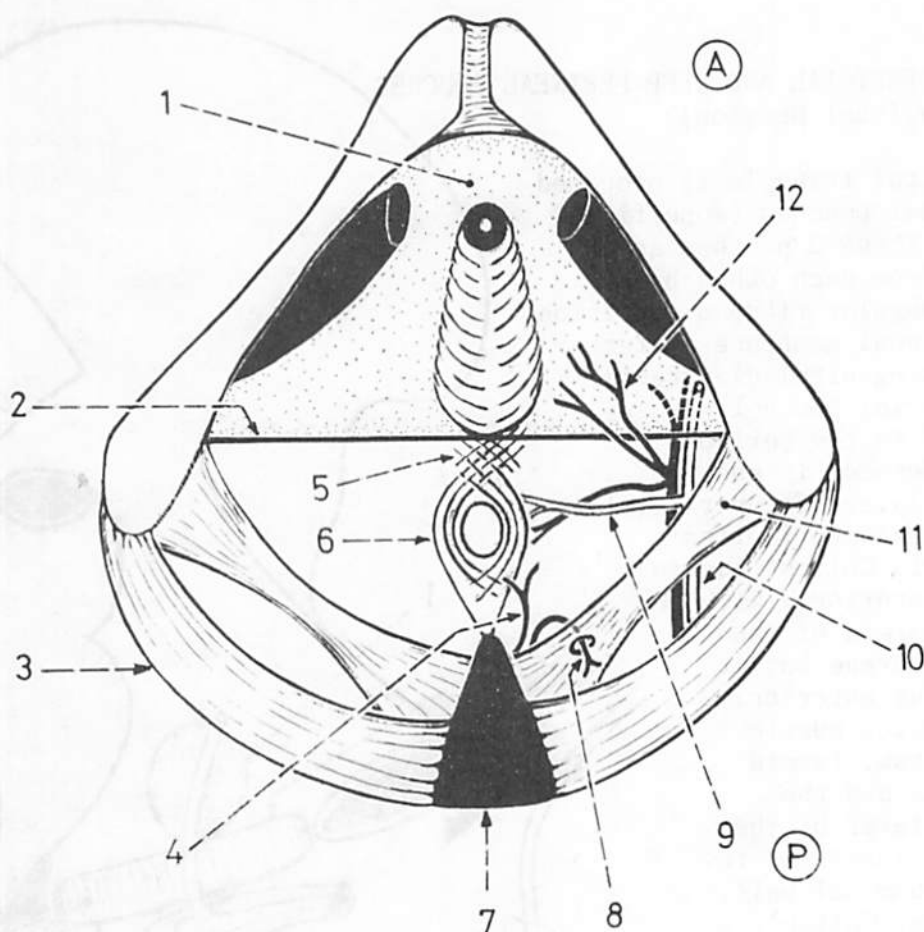


Fig.(503): BOUNDARIES AND CONTENTS OF ISCHIO-RECTAL FOSSA
(horizontal section)

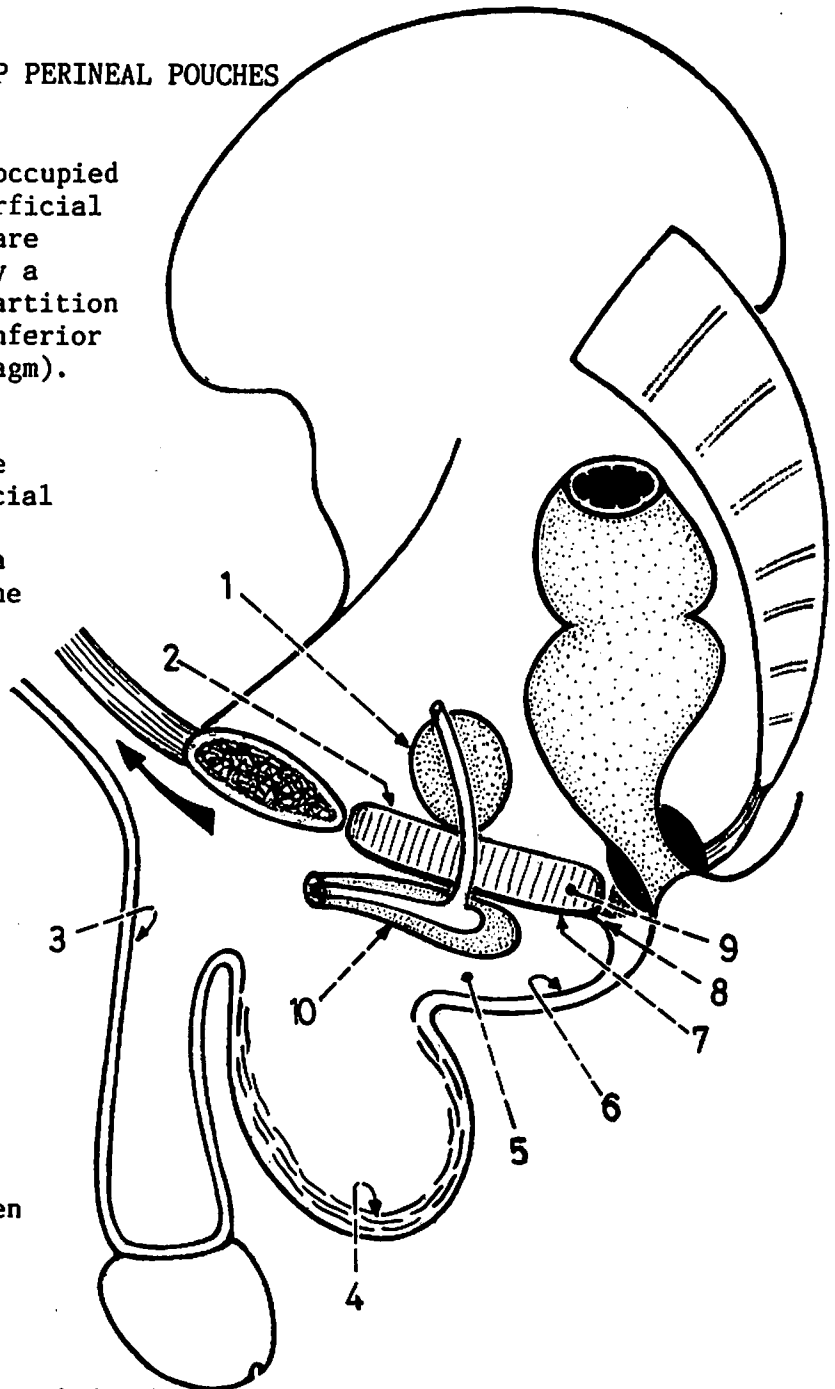
The ischio-rectal fossa is bounded anteriorly by the posterior margin of the urogenital diaphragm and bounded posteriorly by the sacrotuberous ligament and lower border of gluteus maximus. It has the following contents: perineal branch of 4th sacral nerve and perforating cutaneous branch of the sacral plexus (posteriorly), internal pudendal vessels and pudendal nerve (laterally), posterior scrotal or labial nerves and vessels (anteriorly), inferior rectal nerve and vessels (cross from lateral to medial) and a large pad of fat.

1. perineal membrane (inferior fascia of urogenital diaphragm).
2. posterior margin of urogenital diaphragm (anterior boundary of ischio-rectal fossa).
3. lower border of gluteus maximus (posterior boundary of the fossa).
4. perineal branch of 4th sacral nerve.
5. perineal body.
6. external anal sphincter surrounding the anal canal.
7. coccyx.
8. perforating cutaneous branch of sacral plexus.
9. inferior rectal artery and nerve.
10. internal pudendal artery and pudendal nerve in the pudendal canal.
11. sacrotuberous ligament (posterior boundary of the fossa).
12. posterior scrotal or labial nerves.

Fig.(504): SUPERFICIAL AND DEEP PERINEAL POUCHES
(sagittal section)

The urogenital triangle is occupied by 2 perineal pouches (superficial and deep). These 2 pouches are separated from each other by a thick, triangular fibrous partition called perineal membrane (inferior fascia of urogenital diaphragm). The superficial pouch lies superficial to the perineal membrane, between it and the membranous layer of superficial fascia of perineum (Colles' fascia). This Colles' fascia is fused posteriorly with the posterior margin of the perineal membrane but it is continuous anteriorly with the dartos muscle of the scrotum, fascia of the penis and the membranous layer of the superficial fascia of the anterior abdominal wall. On each side, Colles' fascia is attached to the sides of the pubic arch as far as the ischial tuberosities. Accordingly, the superficial pouch is closed posteriorly but open anteriorly.

The deep pouch lies deep to the perineal membrane between it and the superior fascia of urogenital diaphragm; it is a closed space .



1. prostate.
2. superior fascia of urogenital diaphragm.
3. fascia of the penis (Colles' fascia).
4. dartos muscle.
5. superficial perineal pouch.
6. Colles' fascia.
7. perineal membrane.
8. fusion between Colles' fascia and perineal membrane.
9. deep perineal pouch (closed space).
10. part of the root of the penis (a content of the superficial perineal pouch).

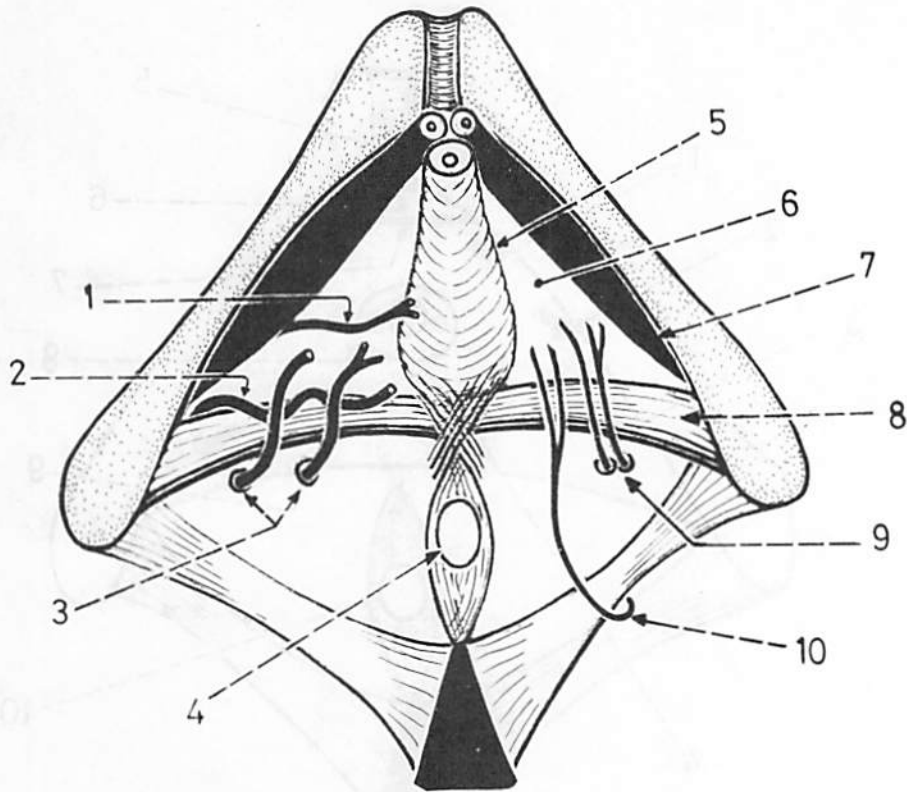


Fig.(505): CONTENTS OF SUPERFICIAL PERINEAL POUCH IN THE MALE

These are the root of the penis (the bulb and the 2 crura), muscles (bulbo-spongiosus, ischiocavernosus and superficial transversus perinei), nerves and vessels (from the pudendal nerve and the internal pudendal artery).

1. artery of the bulb.
2. transverse perineal artery.
3. posterior scrotal vessels.
4. anal canal.
5. bulb of the penis covered with bulbospongiosus muscle.
6. perineal membrane (deep to the root of the penis).
7. crus of the penis covered with ischiocavernosus muscle.
8. superficial transversus perinei muscle (extends transversely superficial to the posterior border or base of the perineal membrane).
9. posterior scrotal nerves.
10. perineal branch of posterior cutaneous nerve of thigh.

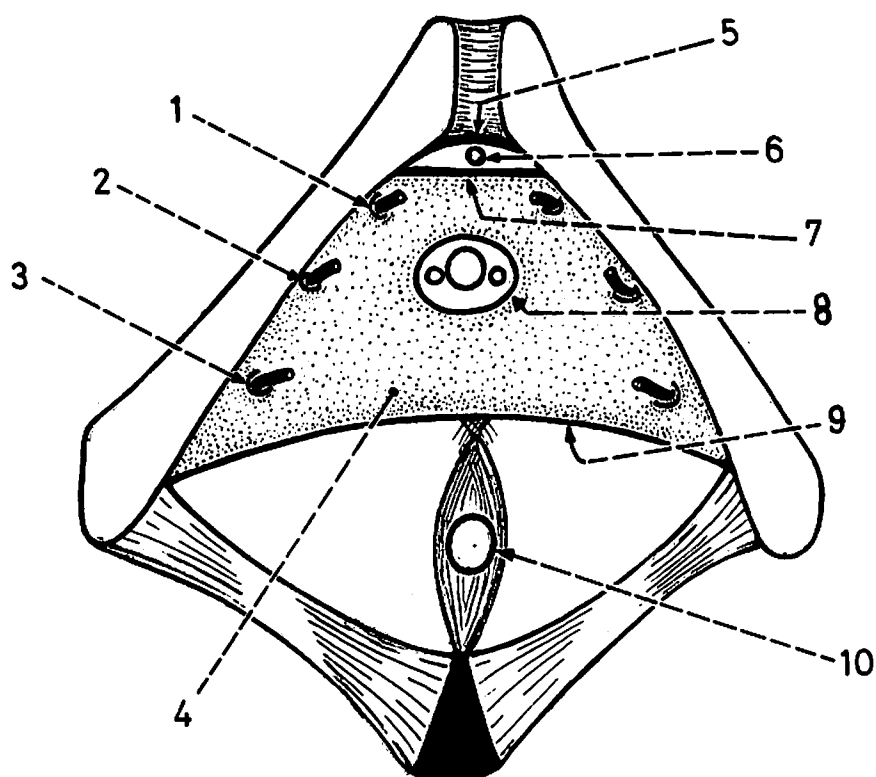


Fig.(506): PERINEAL MEMBRANE (INFERIOR FASCIA OF UROGENITAL DIAPHRAGM)

It is a strong, triangular fibrous membrane which stretches between the 2 sides of the pubic arch. Its base or posterior border is directed backwards and runs between the 2 ischial tuberosities. This posterior border is continuous with Colles' fascia (towards the surface) to form the superficial perineal pouch and with the superior fascia of urogenital diaphragm (towards the pelvic cavity) to form the deep perineal pouch. The apex of the membrane is directed forwards (in the anatomical position) towards the symphysis pubis where it is thickened to form the transverse perineal ligament.

The membrane shows many perforations which are arranged as follows: a large perforation in its midline for ducts (membranous urethra and ducts of bulbo-urethral glands), and 3 perforations on each side close to its attachment to the pubic arch for blood vessels.

1. dorsal artery of the penis.
2. deep artery of the penis.
3. artery of the bulb.
4. perineal membrane.
5. inferior (arcuate) pubic ligament.
6. deep dorsal vein of the penis (enters the pelvis to join the prostatic venous plexus).
7. transverse perineal ligament (forms the apex of the membrane).
8. large perforation for membranous urethra and the ducts of the 2 bulbo-urethral glands.
9. base or posterior border of perineal membrane.
10. anal canal.

Fig.(507): PERINEAL BODY IN THE MALE

It is a fibromuscular mass situated in the midline of the perineum, about 1 cm in front of the anal orifice and just behind the bulb of the penis. This body receives the insertion of 8 muscles which converge upon it, viz. sphincter ani externus, bulbospongiosus, 2 superficial and 2 deep transversus perinei and anterior fibres of the 2 levator ani.

1. bulbospongiosus muscle.
2. perineal body.
3. superficial transversus perinei muscle.
4. anal canal surrounded by the external anal sphincter.

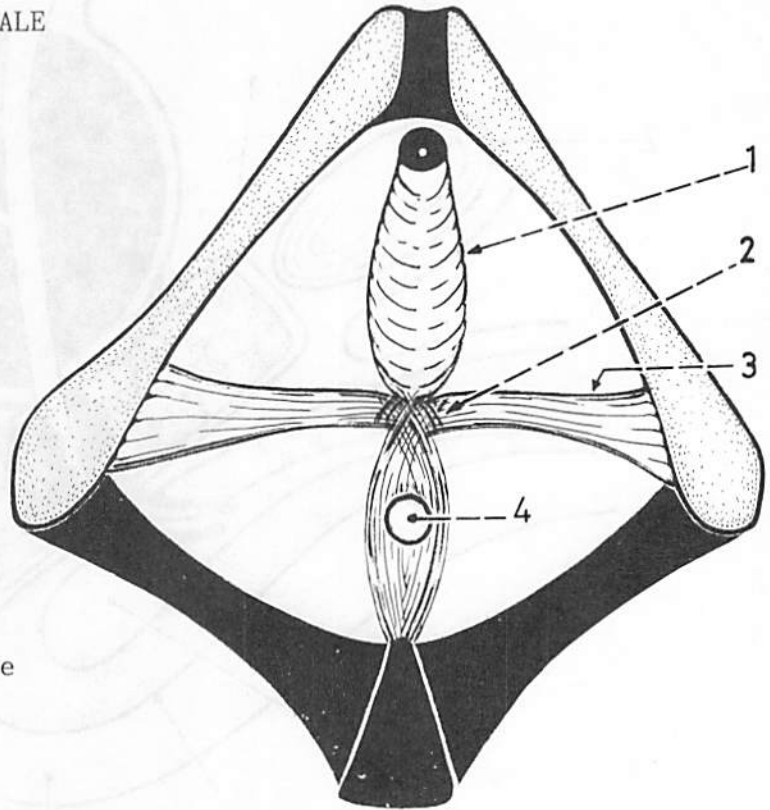
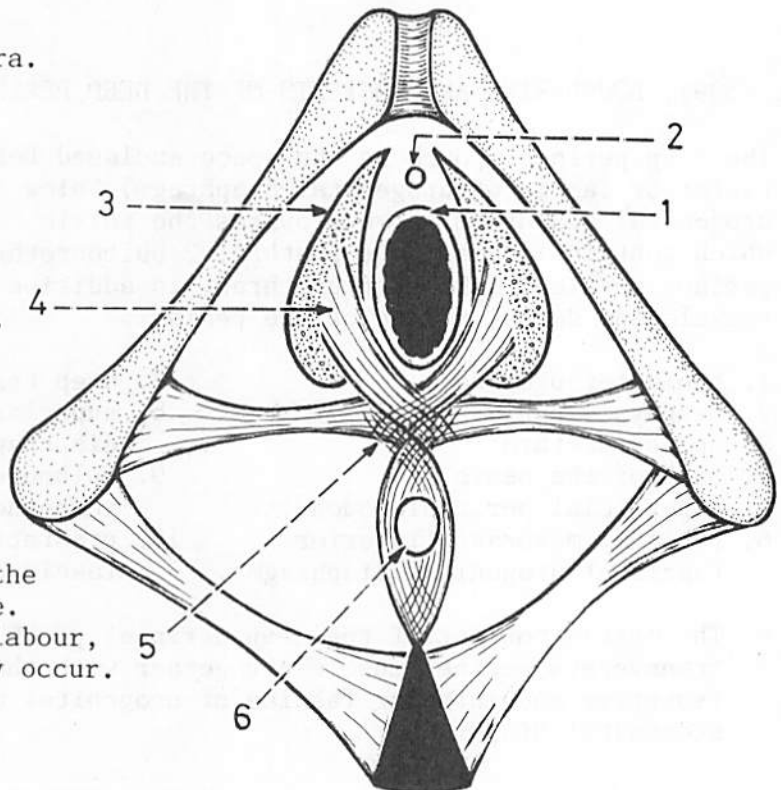


Fig. (508): PERINEAL MEMBRANE IN THE FEMALE

The perineal membrane is perforated in its midline by both the vagina and urethra. On each side of the vaginal orifice lies 1/2 of the bulb of the vestibule with its covering bulbospongiosus muscle.

1. vaginal orifice.
2. external urethral orifice.
3. half of the bulb of the vestibule.
4. bulbospongiosus muscle.
5. perineal body.
6. anal canal.

* The perineal body is of importance in supporting the pelvic floor in the female. If it is ruptured during labour, prolapse of the uterus may occur.



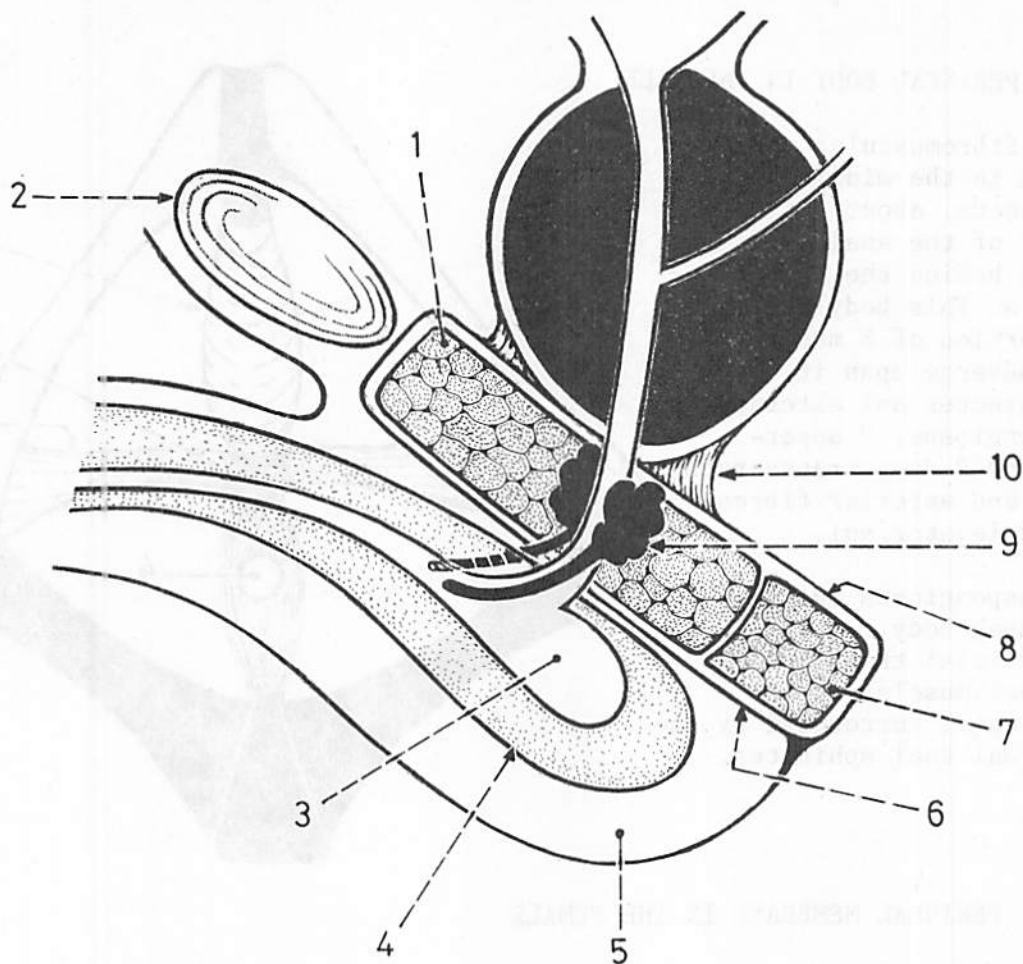


Fig.(509): BOUNDARIES AND CONTENTS OF THE DEEP PERINEAL POUCH (sagittal section)

The deep perineal pouch is the space enclosed between the perineal membrane (inferior fascia of urogenital diaphragm) below and the superior fascia of urogenital diaphragm above (towards the pelvic cavity). It is a closed space which contains: membranous urethra, 2 bulbourethral glands, 2 deep transversus perinei muscles, sphincter urethrae, in addition to the internal pudendal vessels and dorsal nerves of the penis.

- | | |
|---|--|
| 1. sphincter urethrae. | 7. deep transversus perinei muscle. |
| 2. symphysis pubis. | 8. superior fascia of urogenital diaphragm. |
| 3. spongy urethra. | 9. bulbourethral gland on the side of the membranous urethra. |
| 4. bulb of the penis. | 10. prostatic fascia fused with the superior fascia of urogenital diaphragm. |
| 5. superficial perineal pouch. | |
| 6. perineal membrane (inferior fascia of urogenital diaphragm). | |

* The muscle content of the deep perineal pouch (sphincter urethrae and deep transversus perinei muscles) together with the surrounding fascial layers (superior and inferior fasciae of urogenital diaphragm) form what is called urogenital diaphragm.

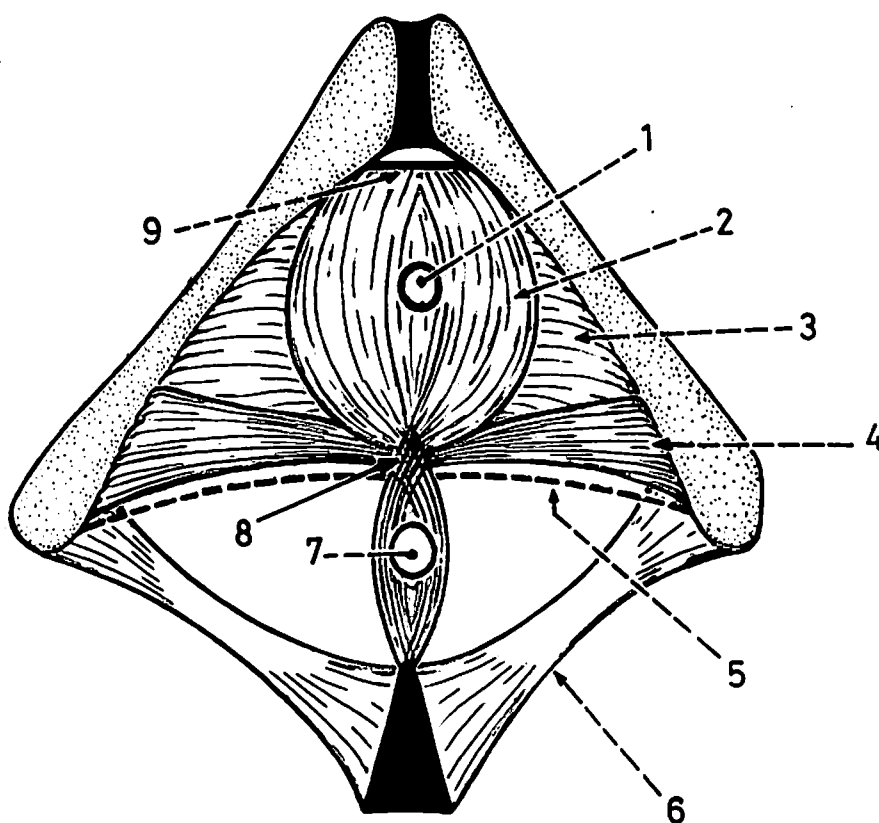


Fig.(510): MUSCLE CONTENT OF THE DEEP PERINEAL POUCH

These are the sphincter urethrae and the deep transversus perinei muscles. They fill the triangular interval bounded by the sides of the pubic arch and act together with the 2 layers of fascia enclosing them (superior and inferior fasciae of pelvic diaphragm) as a diaphragm called urogenital diaphragm.

The sphincter urethrae lies in front of the deep transversus perinei and consists of 2 parts (superficial and deep). The superficial part of the sphincter urethrae runs from the transverse perineal ligament anteriorly to the perineal body posteriorly, while the deep part runs transversely to encircle the membranous urethra.

1. membranous urethra.
2. superficial part of sphincter urethrae.
3. deep part of sphincter urethrae.
4. deep transversus perinei.
5. line indicating the base of the perineal membrane.
6. sacrotuberous ligament.
7. anal canal
8. perineal body.
9. transverse perineal ligament.

